Appendix N

Transportation Technical Report

Transportation Technical Report

Prepared for:

City of Seattle Strategic Planning Office

as part of

Downtown Height & Density
Environmental Impact Statement

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EXECUTIVE SUMMARY

Purpose and Objective

The purpose of this EIS is to study four alternatives for possible changes to height and density regulations within portions of Seattle's Downtown Urban Center. These changes, if adopted, would influence the maximum height and size of future building projects allowed in the Commercial Core, the Denny Triangle, and an edge of Belltown. None of the alternatives have been chosen as a preferred alternative. Rather, this EIS is intended to analyze the impacts of alternative courses of action, for the benefit of decision makers, agencies and interested citizens.

The following are general objectives of the alternatives studied in this EIS:

Designate adequate zoned development capacity in the Downtown Urban Center to encourage long-term residential and commercial growth and economic development, in a manner consistent with Downtown's position as the largest urban center in the metropolitan area.

Define regulatory requirements that will encourage development that is consistent with the City's Comprehensive Plan and neighborhood plans, and will support Downtown's vibrant urban character. Make changes that will aid in realizing a mix of low, moderate and market rate affordable housing throughout Downtown, particularly in areas intended to be "residential enclaves."

Study possible changes to height and density regulations in the Commercial Core (particularly Office Core zones) and Denny Triangle portions of Downtown.

Determine how to best accommodate growth while maintaining a functional transportation system, including the street network, transit, and non-motorized modes of travel. Similarly, determine how to best accommodate growth while maintaining the function and capacity of utility systems, including but not limited to electrical energy, water, sewer and stormdrain systems.

- Achieve a high quality urban environment that can accommodate high-density development while ensuring livability and enhancing Downtown's positive existing characteristics.

Comparison of Alternatives

The chart below provides a brief summary of the alternatives considered in the Downtown Height & Density EIS. For further detail, please refer to Chapter 2 of the EIS.

Table 1: Summary of Alternatives

Alternative 1 **High End Height and Density Increases**	**Alternative 2** **Concentrated Office Core**
135-ft. height increase in DOC 1 and 100-ft. increases in all Denny Triangle zones 30% height increase in zones at edge of office and retail cores 4 FAR maximum density increase in Denny Triangle DOC 2 zone and 3 FAR maximum density increase in other zones 1 FAR increase in base FAR in DOC 1 zone and DOC 2 zones outside Denny Triangle; 2 FAR increase in base FAR in DMC zones and DOC 2 zone in Denny Triangle. No TDC in Denny Triangle zones	100 and 135-ft. height increases to the DOC 1 and DOC 2 zones 30% height increase only at southern edge of office core 3 FAR maximum density increases in DOC 1 and DOC 2 zones No increase in base FAR No height or density changes in western or northern DMC zones at periphery of the office/retail core TDC limited to DMC zones in Denny Triangle
Alternative 3 **Residential Emphasis**	**Alternative 4** **No Action**
135-ft. height increase in DOC 1 and 100-ft. increase in Denny Triangle DOC 2 between 5th/6th and 8th Avenues, west to Blanchard St. No other height increases 3 FAR maximum density increase in DOC 1 and same DOC 2 area described above No increases in base FAR Rezone Denny Triangle mixed-use area between Westlake, Howell and Minor Ave. from DMC to DMR/C, lowering density from 7 FAR to 5 and 4. This re-orients the zoning to mixed residential development. Rezone Belltown southern edge from DMC to DMR/C, lowering density from 7 FAR to 5. In other Denny Triangle and Commercial Core DMC zones, require the use of non-residential density (above the base) to be contingent upon including on-site housing. TDC remains in all Denny Triangle zones except portion of DOC 2 with height and density increases.	No changes in allowable height or density Existing optional height increases would be available, through use of bulk limitations, use of TDC program, preservation of landmarks or small structures on-site, or provision of on-site open-space usable to public. Optional height increases range from 10% to 30% above mapped height limits.

Source: SPO, 2002

Summary of Findings

Travel Characteristics and Traffic Circulation

Impacts

Significant changes in travel conditions are projected to occur with or without zoning changes due to the amount of Downtown growth projected between current conditions and the 2020 baseline condition (Alternative 4 – No Action). The ability for traffic to circulate on the street network will significantly change by 2020, with or without zoning changes. However, there are relatively limited differences in year 2020 peak-hour traffic impacts among the land use zoning alternatives. The biggest impacts are projected to occur along Stewart Street in the PM peak hour, Olive Way in the AM peak hour, and Denny Way in both directions during both peak hours.

Specific findings include the following:

- For the most affected study area location (the Denny triangle neighborhood), traffic volume growth is predicted to range from 15 to 150 percent greater in the 2020 baseline condition than under existing conditions.
- In most cases, the projected traffic volumes for the three land use zoning alternatives are within five percent of the volumes projected for the 2020 baseline condition. The biggest exception is Screenline 8 at the northeast corner of the Denny Triangle near the Denny Way/Stewart Street intersection, where Alternative 1, the "High End" alternative, would result in approximately 8 percent more traffic in the PM peak hour than the 2020 baseline condition.
- Data from Screenlines 2, 6 and 7 indicate that PM peak-hour traffic in 2020 will use a large portion of the available road capacity in the Downtown commercial core and the Denny Triangle neighborhood. This information illustrates that regardless of potential zoning changes, growth over 20 years will generate additional traffic volumes and additional strain on the existing street network.

Mitigation

Possible mitigation strategies discussed fall into two basic categories – those that focus on ways to reduce traffic demand, and those that are aimed at better accommodating anticipated traffic demands.

Regarding traffic demand reduction strategies, it is noted that the future baseline condition, assuming implementation of LINK light rail from Northgate to South 200th Street, already assumes a dramatic increase in transit ridership (160 percent increase over existing ridership) and transit mode share (33 percent in 2020 versus 20 percent currently) of Downtown oriented trips. With respect to additional mitigation, greater implementation of transportation demand management (TDM) strategies coordinated through worksites is recommended, such as:

- Greatly reduced price transit passes (e.g., Flex Pass)
- Subsidization of other alternative modes (walking, biking)
- Increased telecommuting
- Business use of vans
- Carsharing
- Preferential parking for carpools/vanpools
- Guaranteed ride home
- Computerized ridematching database and mapping services

Mitigation measures aimed at better accommodating projected traffic levels are generally limited to strategies such as the optimization of traffic signal timings, and alternate uses of street pavement (e.g., utilizing parking lanes for travel during peak periods). This is because of right-of-way constraints and the overwhelming cost of significant expansion of Downtown streets. However, for one location (the intersection of Stewart Street and Denny Way), a grade-separated intersection is presented as an option. Also, the potential benefits of Alaskan Way Viaduct Project improvements to the east-west grid network across Aurora Avenue are qualitatively addressed. Specific mitigation strategies presented include the following:

Restriping Stewart Street between Yale and Sixth Avenue to allow for four ten-foot travel lanes and (along most segments) an eight-foot parking lane during the AM and PM peak periods

Analysis indicates that strategy could decrease average travel times through the corridor by 1.2 minutes (or about 10 percent) in the PM peak hour. However, in the AM peak hour, it appears to result in a slight increase in delay through the corridor.

A second restriping option for Stewart Street between Yale and Sixth Avenue

A second restriping option was also considered, which allowed for four 12-foot travel lanes and no on-street parking during the AM or PM peak periods. On-street parking would be allowed on the right side during the off-peak hours and three lanes would be used for off-peak travel. An assessment of this strategy indicates that it could decrease travel times through the corridor by close to a minute, resulting in a six percent improvement in the PM peak hour. In the AM peak hour, the net change in delay would be negligible.

Retiming traffic signals along Stewart Street

Retiming these traffic signals would help optimize corridor traffic flow. This strategy is expected to have the most significant effect on PM peak-hour operations, because the signals are already timed to facilitate traffic progression in the AM peak hour, but not necessarily in the PM peak, since this is currently the “off-peak” direction.

Constructing a grade-separated intersection of Stewart Street with Denny Way

This intersection is currently operating at LOS F, and is an important crossroads adjacent to the Denny Triangle neighborhood, which is projected to receive a large amount of growth over 20 years. Traffic operations at this location are anticipated to degrade significantly. Grade-separating this intersection could provide significant relief to both the Denny Way and Stewart Street corridors.

Potential Mitigation Strategies for Olive Way

Restriping Olive Way between Fourth and Eighth Avenues

This restriping would allow for four travel lanes during both the AM and PM peak periods. Parking would be allowed in the off-peak period where it exists today. An assessment of this strategy indicates that it could decrease travel times through the corridor by two minutes (31 percent) in the AM peak hour, and by 1.7 minutes (32 percent) in the PM peak hour.

Retiming traffic signals along Olive Way to optimize corridor traffic flow

This strategy is expected to have the most significant effect on AM peak-hour operations, because the signals are already timed to facilitate traffic progression in the PM peak hour, but not necessarily in the AM peak hour, since this is currently the "off-peak" direction.

Potential Mitigation Strategies for Denny Way

Constructing a Grade Separated Intersection of Stewart Street with Denny Way

See previous discussion.

Placing Aurora Avenue in a tunnel from the downtown area to north of Broad Street

This is an improvement in the South Lake Union area that is being considered as part of the Alaskan Way Viaduct Project. This would allow the reconnection of several east/west arterial streets currently severed by Aurora Avenue north of Denny Way. This would allow for more east/west traffic capacity, and potentially reduce the amount of traffic using Denny Way (particularly in the western portion of the corridor). Although assessment of these impacts to Denny Way are beyond the scope of this study, separate studies analyzing the overall impacts of these improvements are currently underway.

Transit Service

Impacts

As with general-purpose traffic, significant changes in transit operating conditions are projected to occur with or without zoning changes between now and the 2020 baseline condition (Alternative 4 – No Action). This is largely due to the influence of general traffic conditions.

Mitigation

As with traffic-oriented strategies, appropriate mitigation strategies for transit include those aimed at reducing the overall number of trips on these streets and/or enhancing traffic flow. In most cases, traffic circulation mitigation will have corresponding benefits for transit. However, the following transit-specific mitigation measures may also have merit:

- *Restriping Stewart St. from Yale Avenue to Sixth Avenue & Olive Way from Fourth Avenue to Eighth Avenue to accommodate a right-side peak-period transit-only lane*

  Restriping would allow for up to three twelve-foot travel lanes and a twelve-foot transit-only lane on Stewart Street, with narrower lanes along Olive Way. The transit-only lane could be available for parking during off-peak hours. An assessment of this strategy indicates that it could improve average bus travel times along Stewart Street by 1.2 minutes (27 percent) in the AM peak hour, and 8.3 minutes (70 percent) in the PM peak hour. Note that a significant portion of the travel-time savings (nearly 5 minutes) in the PM peak hour is projected to occur at Yale Avenue. If the transit lane started downstream of this intersection, or not far enough upstream of the intersection to provide an adequate queue bypass, the improvement would be much less. Along Olive Way, the transit lane would be expected to reduce AM peak-hour travel times by approximately one minute in both the AM and PM peak hours, which is equivalent to a 15 and 19 percent improvement, respectively.

Regarding cumulative bus travel time delay for the two corridors combined, implementing these transit lanes is estimated to result in an overall decrease of 161 minutes in peak-hour bus-minutes of travel (25 percent improvement) in the AM peak hour, and a decrease of 484 minutes (106 percent improvement) in the PM peak hour.

With this configuration, operations along Stewart Street for general-purpose traffic are estimated to improve slightly in the AM peak hour, with average travel time through the corridor reduced by 0.5 minutes (11 percent) in the general-purpose lanes, compared to Alternative 4 – No Action. PM peak-hour results along Stewart Street are more pronounced, with travel times projected to decrease by 2.4 minutes (roughly a 20 percent improvement). Along Olive Way, AM peak-hour results show a travel time improvement for general-purpose traffic of 1.8 minutes (27 percent) over Alternative 4 – No Action. PM peak-hour results showed no noticeable change in travel times for general-purpose traffic with this measure.

In the Denny Way corridor, target transit queue jumps at intersections with significant queues

Under all of the alternatives, Fairview Avenue North would experience the longest queues and would likely benefit from a queue jump. Other intersections with significant delays that could also benefit from a signal queue jump include Fifth Avenue North, the Aurora Avenue North ramps, and Dexter Avenue North.

Conclusions

Without mitigation, future development through the year 2020 is projected to generate additional traffic volumes and increase congestion in portions of Downtown, most notably in the Denny Triangle neighborhood. Much of this impact would occur with or without zoning changes. However if the higher-density zoning changes (Alternatives 1 and 2) considered in this study are implemented, congestion in the most affected areas could be approximately 5-10 percent worse than for other alternatives, including the 2020 baseline condition (Alternative 4 - No Action). Under all the alternatives considered, additional congestion will likely increase overall travel times on Denny Way, Stewart Street and Olive Way, including transit travel time. Implementation of mitigation strategies, at the City's discretion, would likely improve overall transportation conditions, so that a portion of the impacts of traffic congestion could be avoided.

I. AFFECTED ENVIRONMENT

A. Travel Characteristics

According to the City of Seattle's travel demand forecasting model, Seattle's downtown area currently serves as the origin and/or destination for about 26 percent of daily person trips in the City of Seattle. On an average weekday, over 815,000 person trips are estimated to have an origin and/or destination within the Downtown area. Information from the Puget Sound Regional Council's travel demand model indicates that about 20 percent of these Downtown-oriented trips are made by transit. The average weekday vehicle trips with an origin and/or destination in the Downtown area number about 519,400, carrying approximately 655,000 persons, which equates to an average auto occupancy of 1.26 persons per vehicle.

A view of travel patterns (including both through and local trips) within and through the Downtown area can be seen by examining travel volumes across imaginary lines called screenlines. Screenline volumes provide an indicator of general traffic flow from one area to another. In examining screenline volumes, it is more useful to look at peak-period patterns than daily totals. Figure 1 shows the location of nine screenlines in the Downtown area: three of these measure north–south traffic and six measure east–west traffic. The screenline locations were chosen in an attempt to capture all traffic entering and leaving the study area. Streets included in each of the screenlines are listed in Appendix A.

When reporting screenline volume results, it is also useful to look at volume-to-capacity (v/c) ratios. These ratios are an indicator of whether the screenline volumes are close to the carrying capacity of the streets crossing them. In calculating this value, typical capacities for streets are used, but because the capacity of a roadway is not a hard and fast value, typical capacities can be exceeded. For this reason, a value of 1.20 for a given screenline in this study indicates that the streets crossing the screenline are likely to be at their ultimate capacity. A value exceeding 1.20 indicates that there is more volume desiring to use the streets crossing the screenline than could typically be physically accommodated. Values of 0.80 to 1.00 indicate that the screenline is moderately congested, and values ranging from 1.00 to 1.20 indicate more congested conditions. For the purposes of this study, a capacity of 600 vehicles per lane per hour was assumed.

Of the nine total screenlines chosen for this transportation study, three are consistent with screenlines used by the City of Seattle's Comprehensive Plan's level-of-service (LOS) system, and three others resemble three that were defined for a forecast analysis in the Comprehensive Plan's Transportation Appendix C. The correspondence between the screenlines used here and the Comprehensive Plan screenlines, along with pertinent LOS standards, are shown in Table 2.

Table 2: EIS and Comprehensive Plan Screenline Correspondence

EIS Screenline	Comprehensive Plan Screenline
7,9	12.12 (LOS Standard: v/c > 1.20)
1	10.11 (LOS Standard: v/c > 1.00)
2	A1
3	A2
6	A3
4,5,8	No corresponding screenline

Table 3 shows peak-hour traffic volumes across these screenlines for the AM and PM peak hours. The volumes shown are the summation of volumes on all individual streets crossing the screenline in both directions. Table 3 also shows the corresponding screenline volume-to-capacity (v/c) ratios. Figures 2 and 3 also show screenline volumes and v/c ratios for the AM and PM peak hours respectively. Note that the City's maximum arterial level of service standard for the Comprehensive Plan Screenline 12.12 (identified above) is a v/c of 1.20.

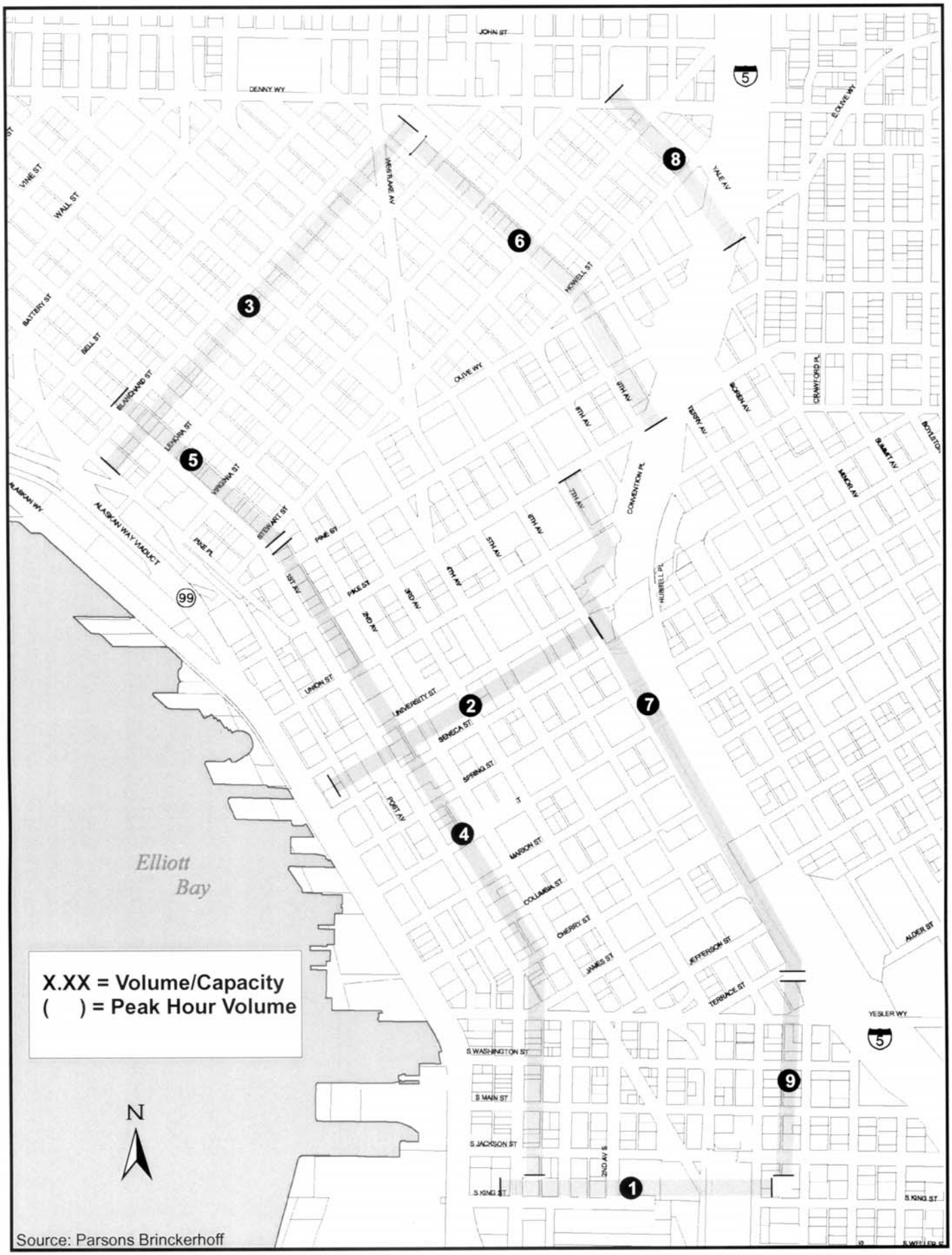
Several patterns can be discerned from looking at screenline volumes and v/c ratios. The screenline with the heaviest crossing volume is number 7, east of Sixth Avenue. This indicates that a large percentage of traffic oriented to downtown Seattle arrives and departs via I-5 (i.e., across Screenline 7, which captures traffic heading to and from the I-5 ramps). Screenline 2 (north of Seneca Street) and Screenline 3 (south of Blanchard Street) also show relatively high volumes. Screenline 2 captures traffic traveling north and south through the heart of downtown Seattle, and heavy volumes are consistent with observations on these streets. Screenline 3 captures north-oriented traffic that arrives/departs Downtown via surface streets. Note that Screenline 3 does not include Aurora Avenue (SR 99), or Elliot or Western Avenues. Traffic from Downtown that accesses these facilities is captured either in Screenline 3 or Screenlines 4 and 5. The predominant access to Downtown from southbound Aurora Avenue is via Battery Street westbound, and via Fifth, Third, Second or First Avenues southbound. Seventh Avenue and Denny way provide a few other options.

Other notable patterns include the fact that for most screenlines, volumes in the inbound direction were higher in the AM than in the PM, and vice-versa for volumes in the outbound direction. As a whole, in the AM peak hour approximately 57 percent of the traffic crossing the screenlines is traveling into the study area, and 43 percent is outbound. In the PM peak hour, 59 percent is outbound and 41 percent is inbound. Another observation is that when summing up volumes across all screenlines, PM peak-hour traffic is roughly 12 percent higher than AM peak-hour traffic.

With respect to v/c ratios, only the following two screenlines have ratios of 0.80 or higher, which indicates potentially congested operations:

Screenline 7, east of Sixth Avenue - eastbound in the PM peak hour
Screenline 8, east of Minor Avenue - westbound in the AM peak hour

These results are consistent with observed conditions and with findings that show that a large portion of traffic destined for the study area is oriented either to or from the east (i.e., I-5), or the north via surface streets. Note that much of the traffic across Screenline 8 east of Minor Avenue is from the I-5 southbound mainline off-ramp to Stewart Street, and the I-5 express lanes reversible ramp to Stewart Street. None of the screenlines analyzed exceed the City of Seattle's maximum arterial level-of-service (LOS) standard, which is a v/c ratio of 1.2 or less across an entire screenline.



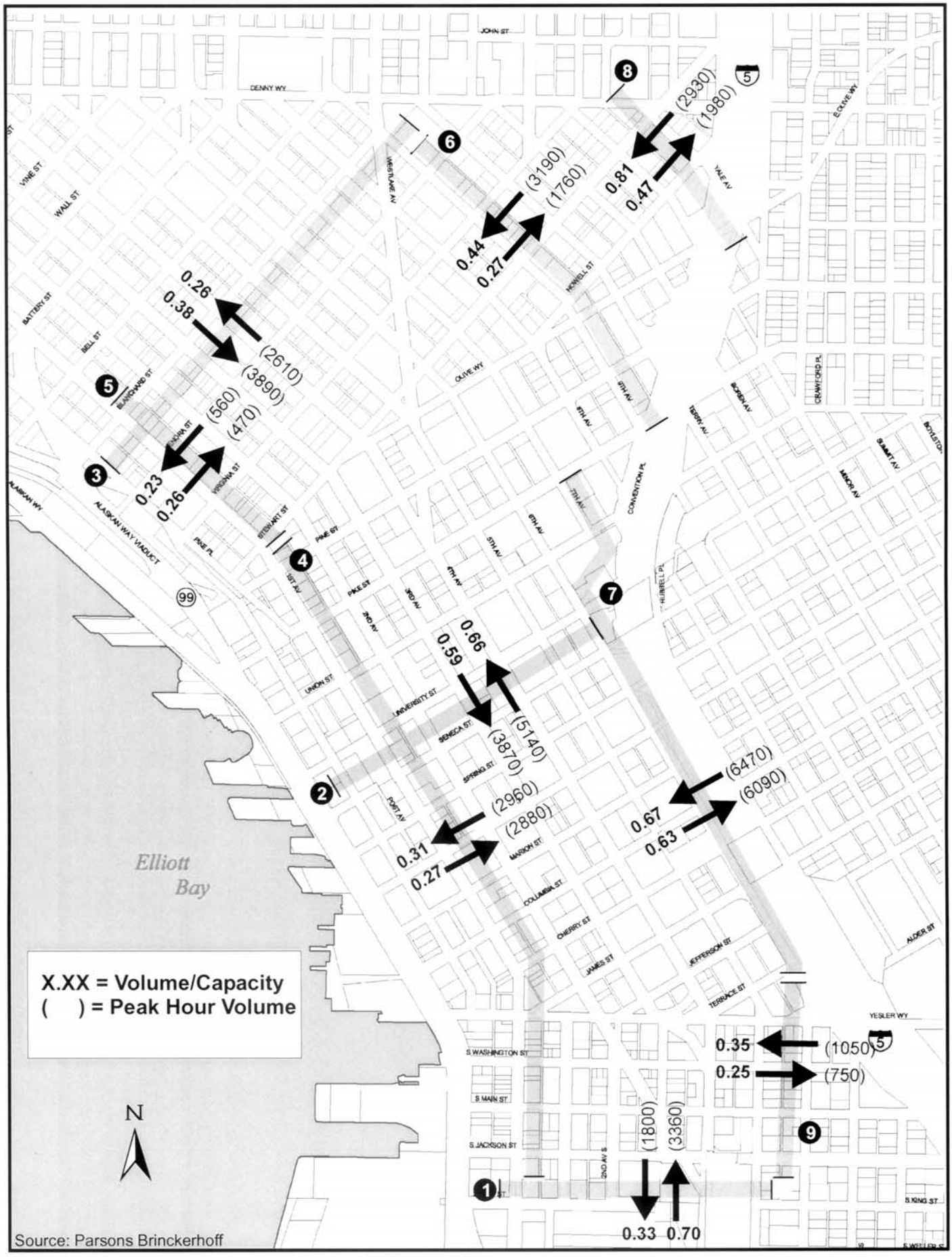
Source: Parsons Brinckerhoff

Downtown Height & Density EIS

Figure 1
Screenline Locations

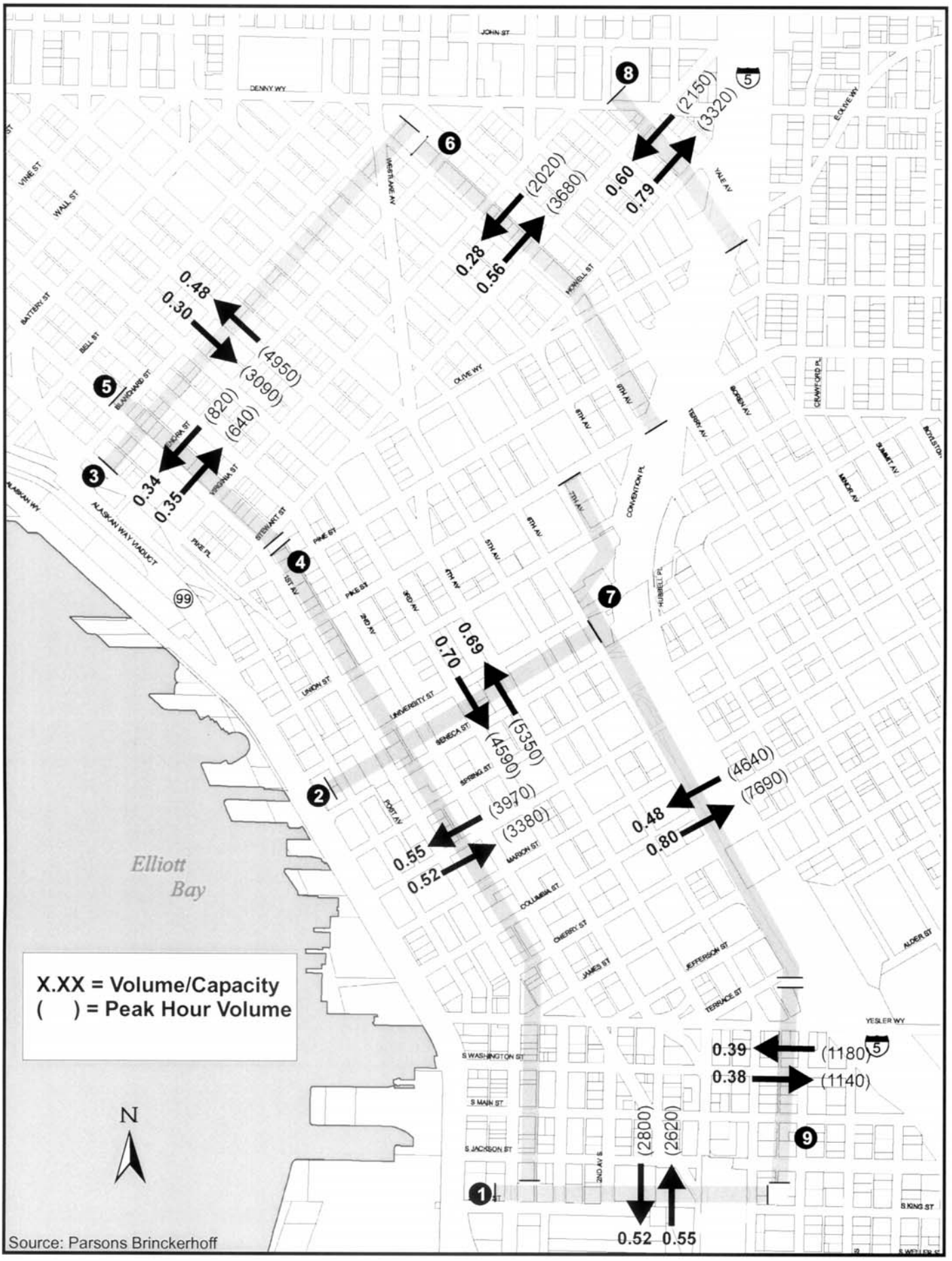
Table 3
Existing Peak Hour Traffic Volumes and V/C Ratios
Across Screenlines

Screenline	Map Key	AM Peak Hour Volume	AM Peak Hour V/C Ratio	PM Peak Hour Volume	PM Peak Hour V/C Ratio
South Screenline: North of S. King St., First Ave. S. to Sixth Ave. S.	1				
Northbound Total		3,360	0.70	2,620	0.55
Southbound Total		1,800	0.33	2,800	0.52
Central Screenline: North of Seneca St., Western Ave. to Sixth Ave.	2				
Northbound Total		5,140	0.66	5,350	0.69
Southbound Total		3,870	0.59	4,590	0.70
North Screenline: South of Blanchard St., Elliott Ave. to Ninth Ave.	3				
Northbound Total		2,610	0.26	4,950	0.48
Southbound Total		3,890	0.38	3,090	0.30
West Screenline 1: East of First Ave., S. Jackson St. to Pine St.	4				
Westbound Total		2,960	0.31	3,970	0.55
Eastbound Total		2,880	0.27	3,380	0.52
West Screenline 2: East of First Ave., Stewart St. to Blanchard St.	5				
Westbound Total		560	0.23	820	0.34
Eastbound Total		470	0.26	640	0.35
East Screenline 1: East of Ninth Ave., Lenora St. to Pike St.	6				
Westbound Total		3,190	0.44	2,020	0.28
Eastbound Total		1,760	0.27	3,680	0.56
East Screenline 2: East of Sixth Ave., Union St. to S. Jackson St.	7				
Westbound Total		6,470	0.67	4,640	0.48
Eastbound Total		6,090	0.63	7,690	0.80
East Screenline 3: East of Minor St., Denny Way to Olive St.	8				
Westbound Total		2,930	0.81	2,150	0.60
Eastbound Total		1,980	0.47	3,320	0.79
East Screenline 4: West of Sixth Ave.	9				
Westbound Total		1,050	0.35	1,180	0.39
Eastbound Total		750	0.25	1,140	0.38



Downtown Height & Density EIS

Figure 2
Existing Screenline Volumes and V/C Ratios
AM Peak Hour



Downtown Height & Density EIS

Figure 3
Existing Screenline Volumes and V/C Ratios
PM Peak Hour

B. Traffic Circulation

The quality of traffic circulation on an arterial street system is generally a result of operating conditions at signalized intersections, since these are the locations where roadway capacity is shared by vehicles moving in conflicting directions. For this transportation study, operating conditions at key intersections along critical corridors serving the Downtown area were examined. The results of these analyses can be expressed in terms of level of service (LOS), a measure that is used to describe traffic flow conditions, ranging from excellent (LOS A) to overloaded (LOS F). The most recent version of the Transportation Research Board Highway Capacity Manual (HCM 2000) categorizes intersection LOS in terms of average delay per vehicle processed by the given intersection. LOS criteria for signalized intersections is described as follows:

LOS A: Average vehicle delay is less than or equal to 10 seconds. Generally, no vehicle waits longer than one signal cycle (red light), and no approach phase is fully used.

LOS B: Average vehicle delay is between 10 and 20 seconds. An occasional approach phase is fully utilized. Many drivers begin to feel somewhat restricted within groups of vehicles.

LOS C: Average vehicle delay is between 20 and 35 seconds. Typically, between 11 and 30 percent of the signal cycles have one or more vehicles that wait through more than one cycle. Backups may develop behind turning vehicles.

LOS D: Average vehicle delay is between 35 and 55 seconds. Delays may be substantial during portions of the peak period, but enough lower volume periods occur to permit clearing of developing queues, preventing excessive backups.

LOS E: Average vehicle delay is between 55 and 80 seconds. This generally represents the most vehicles that the intersection approaches can accommodate.

LOS F: Average vehicle delay is greater than 80 seconds. This is typically known as oversaturation, when arrival flow rates exceed the intersection's capacity.

These level-of-service measures describe operating conditions at signalized intersections. They are not directly related to the City's Arterial Level of Service Standard required by the Growth Management Act. The Arterial Level of Service Standard designated by the City is an area-wide volume- to-capacity ratio measured against all the arterials crossing a screenline or cordon line.

Current Operating Conditions

To assess current and future operating conditions in the study area, this study focuses on two arterial corridors: the Stewart/Howell/Olive Way corridor and the Denny Way corridor. Within these corridors, a total of 38 intersections were analyzed: 26 in the Stewart/Howell/Olive corridor, and 12 along Denny Way. The analysis was conducted using the micro-simulation model Synchro. This model simulates traffic operations at both a corridor and intersection level. The advantage of using the simulation model is that it can indicate how operations at one intersection can impact those at adjacent intersections (e.g., due to queue back-ups or signal phasings and/or timings). This type of analysis provides a more comprehensive picture of operations in the corridor, as opposed to analyzing intersection operations in isolation.

Table 4 lists the calculated AM and PM peak-hour levels of service (LOS) and queuing impacts for each of the 38 intersections analyzed. Figure 4 graphically shows existing AM and PM peak-hour LOS results by intersection location.

AM Peak Hour

The analysis indicates that in the AM peak hour, for the corridors analyzed, only two intersections experienced operating conditions of LOS E or worse. These were at Stewart Street and Denny Way, and Stewart Street and Fifth Avenue. Both of these intersections are operating at LOS F. Note that while other intersections were operating at LOS D or better, many of them still experience queuing problems on one or more approaches, so that queues are backed up enough to affect operations at upstream intersections. This was particularly evident along Stewart Street in the westbound (or inbound) direction, and along Denny Way in both the eastbound and westbound directions between Stewart Street and Sixth Avenue.

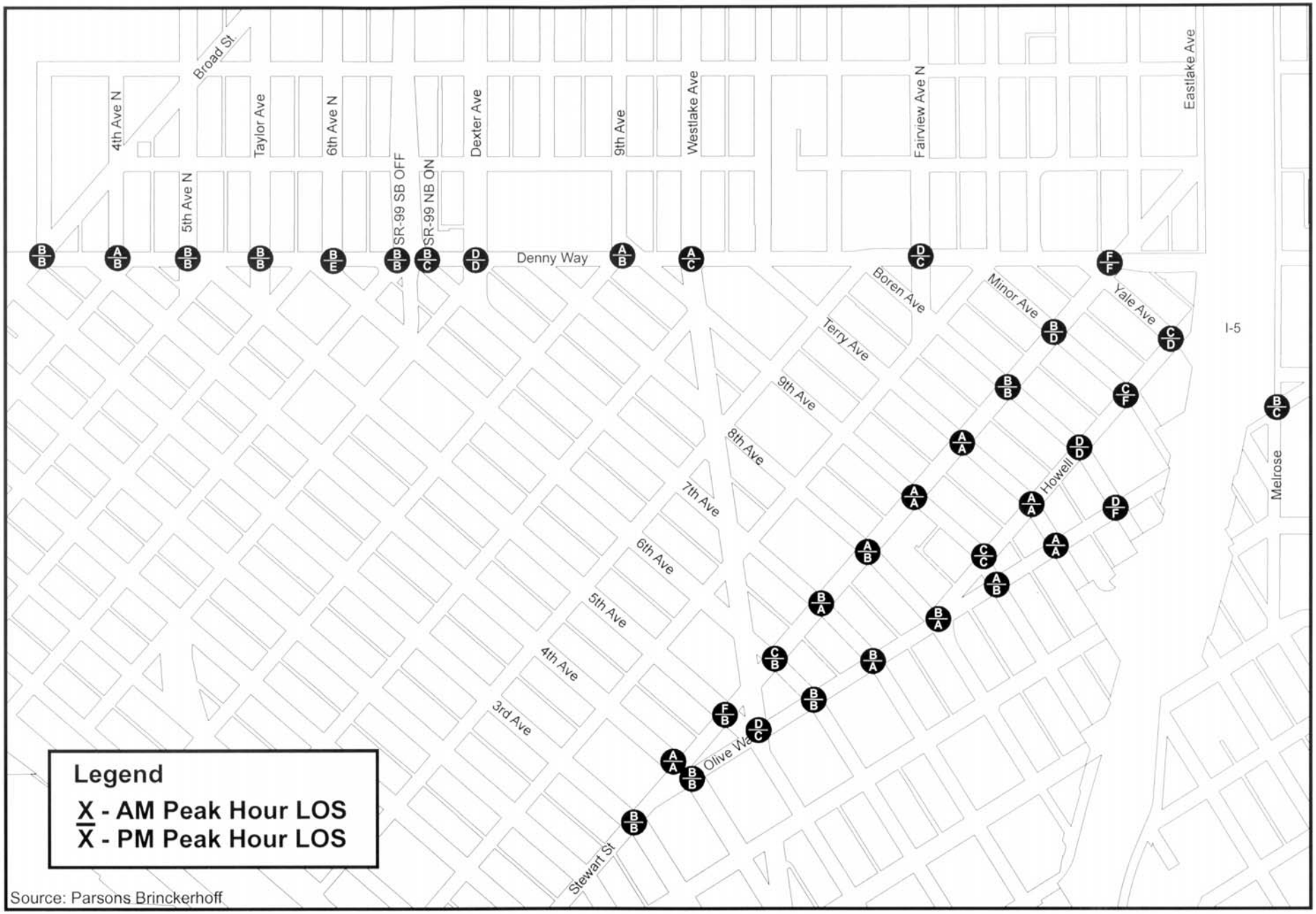
PM Peak Hour

Operations in the PM peak hour are generally more congested than in the AM peak, with five intersections experiencing operating conditions of LOS E or worse. These are the intersections of Stewart and Yale, Howell and Minor, Olive and Boren, Denny and Stewart, and Denny and Sixth Avenue. The queuing analysis for the PM peak hour shows queuing problems along Howell between Boren and Yale Avenues, and along Denny Way in both directions between Stewart Street and Sixth Avenue. These are consistent with field observations that indicate congested PM peak-hour operations along these corridors in these locations. An overall general observation is that congestion on these key corridors is heavier in the AM peak hour for routes serving traffic inbound from I-5 to the downtown area, and in the PM peak hour for routes serving outbound traffic from the downtown accessing I-5.

Table 4
Current Peak Hour Intersection Levels of Service and Queuing Impacts

	AM Peak Hour		PM Peak Hour	
Intersection	**LOS**	**Queuing Impacts***	**LOS**	**Queuing Impacts***
Stewart & 3rd Ave	B	---	B	---
Stewart & 4th Ave	A	WB	A	---
Stewart & 5th Ave	F	SB/WB	B	---
Stewart & Westlake	B	WB	A	---
Stewart & 6th Ave	C	WB	B	---
Stewart & 7th Ave	B	---	A	---
Stewart & 8th Ave	A	---	B	---
Stewart & 9th Ave	A	---	A	---
Stewart & Terry	A	WB	A	---
Stewart & Boren	B	SB	B	SB
Stewart & Minor	B	---	D	SB/WB
Stewart & Yale	B	SB/WB	F	SB/WB
Howell & Yale	C	SB/EB/WB	D	SB/EB
Howell & Minor	C	WB	F	SB
Howell & Boren	D	NB/WB	D	NB/EB
Howell & Terry	A	---	A	---
Howell & 9th Ave	C	---	C	---
Howell & 8th/Olive	B	---	A	---
Olive & Melrose	B	EB	C	EB
Olive & Boren	D	NB	F	EB/NB/SB
Olive & Terry	A	---	A	---
Olive & 9th Ave	A	---	B	---
Olive & 7th Ave	B	---	A	---
Olive & 6th Ave	B	---	B	---
Olive & 5th/Westlake	D	SB	C	---
Olive & 4th Ave	B	---	B	---
Denny & Stewart	F	EB/WB/SW	F	EB/SW
Denny & Fairview	D	EB/WB/NB	C	EB/WB/NB
Denny & Westlake	A	---	C	EB/NB
Denny & 9th Ave	A	EB/SB	B	EB/SB
Denny & Dexter	D	EB/WB	D	EB/WB
Denny & Aurora NB	B	EB/WB	C	EB/WB/NB
Denny & Aurora SB	B	EB/WB/SB	B	EB/WB/SB
Denny & 6th Ave	B	WB	E	EB/WB/NB
Denny & Taylor	B	WB	B	---
Denny & 5th Ave	B	---	B	---
Denny & 4th Ave	A	---	B	---
Denny & Broad	B	---	B	WB

* Direction(s) indicated are for approaches where queues from the specified intersection are calculated to back up and affect operations at adjacent intersections.



Seattle Height & Density EIS

Figure 4
Existing AM & PM Peak Hour Intersection Levels of Service

Corridor Travel Time Summaries

Table 5 shows current average AM and PM peak-hour travel time summaries for the corridors studied. Travel time over a particular route is frequently used as a measure of effectiveness for comparing transportation alternatives. These figures were developed based on output from the Synchro micro-simulation model, and will serve as a baseline from which to compare future year travel time results for the same corridors. It is interesting to note that travel times along Stewart Street in the PM peak hour are considerably longer than in the AM peak hour. This may be due to the fact that Stewart Street serves a higher volume of traffic in the AM peak hour, and signal timings are set to better facilitate these heavier volumes. The same is true (though to a lesser degree) on Olive Way, where PM peak-hour volumes (the heavier movement as compared to AM volumes) experience slightly shorter travel times through the corridor.

Table 5
Current Average Peak Hour Corridor Travel Time Summaries

Corridor	AM Peak Hour (minutes)	PM Peak Hour (minutes)
Denny Way Eastbound	5.5	5.9
Denny Way Westbound	5.9	6.3
Olive Way Eastbound	3.8	3.4
Stewart Street Westbound	4.0	8.5

Assumptions:
* Stewart Street corridor evaluated from Yale Ave to 3rd Ave.
* Olive Way corridor evaluated from 3rd Ave to Boren Ave.
* Denny Corridor (both directions) evaluated from Broad St to Stewart St.
* Average travel speed of 20 mph is assumed from all arterial segments

C. Transit Service

Transit Operations

This section identifies existing conditions related to transit travel time and delay. Transit travel time and delay is typically similar to general-purpose vehicle operations. In the Alternative 4 – No Action and Impacts sections of this report, these travel time and delay values are used to assess the amount of change from existing conditions to Alternative 4 – No Action and the other three land-use zoning alternatives. Because transit service does not vary among the alternatives, the traffic operations section addresses many of the issues that each alternative raises. To distinguish the transit-specific impacts of each alternative, this analysis applies transit volumes on given streets to the identified delay or travel time on the streets (as developed for the traffic operations analysis). This approach has the effect of "weighting" traffic delay by transit volumes across a screenline. Therefore, alternatives with higher levels of delay on high transit volume streets will show a higher corresponding impact for transit.

This analysis considers two corridors and two screenlines. The two corridors—Stewart Street from Yale to Third Avenue, and Olive Way from Third Avenue to Boren Street—were chosen for the following reasons:

They each carry relatively high transit volumes

Peak-hour travel time summaries were available from the traffic circulation micro-simulation analysis to apply to them

For these two corridors, the analysis applies transit volumes to the respective travel times, to develop a combined aggregate bus travel time value for the two corridors. The two screenlines chosen were Screenline 2 (north of Seneca Street) and a screenline (considered specifically for the transit analysis) at Denny Way between Broad Street and Stewart Street. The north of Seneca Street screenline was chosen because it captures a high portion of north/south bus routes through the heart of Downtown. The analysis of transit service across this screenline assesses potential operational impacts, as indicated by the screenline v/c ratio identified in the preceding Travel Characteristics section. Regarding Denny Way, although travel time summaries are available from the traffic circulation analysis for this corridor, very few buses travel the corridor, and corridor travel time impacts therefore have little bearing on transit service. However, a relatively high volume of buses cross Denny Way at a variety of locations. Therefore, assessing operational impacts to buses across this screenline was deemed useful.

This analysis considers both AM and PM peak-hour conditions. Peak hours correspond respectively to 7:30 to 8:30 AM and 5:00 to 6:00 PM. Bus volumes are based on year 2002 schedules and are held as constant for the evaluation period (2000 and 2020).

North of Seneca Street Screenline

The North of Seneca Street Screenline intersects the major transit spine through the downtown Seattle core. Approximately 421 buses move through the corridor in the AM peak hour and 414 in the PM peak hour, representing approximately 5 percent of the traffic stream. Note that this does not include the transit tunnel buses. Transit volumes are roughly equivalent northbound and southbound over the AM and PM peak hours. There is a moderate northbound emphasis in the AM and a southbound emphasis in the PM peak hour. As shown in Table 6, Fourth Avenue and Second Avenue carry the highest transit volumes. These streets serve as the northbound/southbound couplet for transit service through Downtown. Third Avenue also carries a significant number of buses, but lower volumes in both directions. Community Transit and Sound Transit bus service focuses exclusively on Fourth Avenue and Second Avenue.

Table 6
Existing AM and PM Peak Hour Transit Volumes
NB/SB Across the Seneca Street Screenline

Agency	Number of Routes	Northbound Volumes						Southbound Volumes							
		1st Ave		3rd Ave		4th Ave		1st Ave		2nd Ave		3rd Ave		5th Ave	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Metro	43	30	33	68	78	76	51	22	24	48	85	60	62	30	9
CT	15	0	0	0	0	20	21	0	0	27	15	0	0	0	0
ST	11	0	0	0	0	27	11	0	0	13	25	0	0	0	0
Total		30	33	68	78	123	83	22	24	88	125	60	62	30	9

Stewart/Olive Corridors

The transit analysis for the Stewart/Olive corridors builds on traffic travel-time estimates developed for Stewart Street between Yale and Third Avenues, and Olive Way between Third Avenue and Boren Street (see Table 5). The analysis captures some of the impacts that the alternatives may have on regional service and regional transit providers.

Stewart Street and Olive Way serve as the principal transit access points to I-5 in the study area. A total of 149 buses use the corridor in the AM peak hour and 115 in the PM peak hour. As shown in Table 7, Stewart Street and Olive Way experience significant volumes of transit vehicles entering the Downtown in the AM peak hour. The AM emphasis that exists on Stewart Street can be attributed to a directional peak that is supported by a large number of Community Transit buses. Service on Olive Way does not show a directional peak and has fairly balanced volumes in both the AM and PM peak hours, due to a large number of Sound Transit buses returning to I-5 at the end of their Tacoma to Seattle AM service. As shown in Table 8, the overall cumulative peak-hour travel times weighted by bus volumes for the combined Stewart/Olive corridors is 572 bus-minutes in the AM peak hour and 651 bus-minutes in the PM peak hour.

Table 7
Existing AM and PM Peak Hour Transit Volumes
Stewart/Olive Between 7th Avenue and 8th Avenue

Agency	Routes	Eastbound - Olive		Westbound -Stewart	
		AM	PM	AM	PM
Metro	31	27	33	43	31
CT	14	16	21	30	12
ST	6	24	10	9	8
Total		67	64	82	51

Table 8
Existing AM and PM Peak Hour Cumulative Transit Travel Time
Stewart/Olive Corridors

Peak Hour	Total Bus-Minutes
AM	572
PM	651
AM and PM	1223

Denny Way Screenline

The Denny Way Screenline captures more local-bound service than the Stewart Street and Olive Way corridors, with buses generally servicing the north and northwest areas of the city. Approximately 169 buses total in both directions cross the Denny Way screenline at the analysis intersections during the AM and PM peak hours. This includes 81 buses in the AM peak hour, and 88 in the PM peak hour, as shown in Table 9. The cumulative peak-hour delay for buses crossing Denny Way (shown in Table 10) is estimated at 29 bus-minutes in the AM peak hour and 40 bus-minutes in the PM peak hour.

Of the streets crossing Denny Way, Dexter Avenue experiences the highest total delays due to the high numbers of buses using the street and the high average delay at the intersection. A large numbers of buses also use Aurora Avenue and Fifth Avenue North, but fairly modest delays result in moderate levels of aggregate delay. Fourth Avenue, Ninth Avenue and Westlake Avenue carry relatively few buses compared to the other streets in the screenline, and hence have low levels of aggregate delay.

Table 9
Existing AM and PM Peak Hour Transit Volumes
NB/SB Across Denny Way

Agency	Number of Routes	Northbound															
		4th		5th		Aurora		Dexter		9th		Westlake		Fairview		Total	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Metro	16	3	10	11	12	5	11	6	16	0	0	4	6	4	4	33	59
Agency	Number of Routes	Southbound															
		4th		5th		Aurora		Dexter		9th		Westlake		Fairview		Total	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
Metro	10	0	0	9	11	25	10	3	0	6	3	0	0	5	5	48	29
Total		3	10	20	23	30	21	9	16	6	3	4	6	9	9	81	88

Table 10
Existing Cumulative Peak Hour Bus Delay
Denny Way Screenline

Peak Hour	Total Bus-Minutes
AM	29
PM	40
AM and PM	70

Layover

The Transportation Research Board defines a layover zone or space as a designated stopover location for a transit vehicle, at or near the end of the route or line or at a turnback point.

Layover is a critical element in service planning and has direct implications on operating costs and levels of service provided. Metro has a total of 25 existing layover spaces in the study area and has identified an additional 17 potential layover spaces. Community Transit has four layover spaces in the study area. Layover space in the study area is confined to the northern part of the area in the vicinity of Denny Way and Westlake Avenue (Figure 5). This layover area serves coaches with service that originates in the northern area of Downtown and moves south through Downtown and ultimately the Eastside. The layover spots are located in close proximity to route origin points. As shown in Figure 5, these include Second Avenue and Bell Street, Second Avenue and Lenora Street, Third Avenue and Bell Street, and Eighth Avenue and Stewart Street.

Potential layover spaces are spaces that Metro considers feasible based on their proximity to route origin points and having compatible land uses adjacent to them. Potential layover spaces have been identified to provide alternative sites as development displaces existing spaces, and to accommodate projected growth in service and the resulting increased need for layover spaces.

Traditionally, layover space has been located adjacent to vacant lots, parking lots, or buildings with blank walls. This is due to compatibility with adjacent uses and the use of curb space. It is generally considered undesirable to have coaches parked next to residential or commercial uses. For example, a restaurant use is unlikely to tolerate the visual impact, noise and diesel

fumes associated with parked coaches. Vacant lots have the further benefit that they reduce the demand for competing curb uses, such as short-term parking or loading zones.

As development occurs, Metro coordinates with the City's Department of Construction and Land Use (DCLU) and the Seattle Department of Transportation to address any impacts that development may have on layover space. Seattle Transportation's starting point for examining layover issues is to assume that any displaced layover site will be accommodated somewhere on the same block. However, given the competing priorities associated with developing a land parcel, this is not always feasible. As a result, Metro must routinely evaluate its layover sites and search for new potential sites.

The designation of Green Streets in the study area will likely reduce the number of potential layover sites in the study area. The City's code defines a Green Street as a street right-of-way that is part of the street circulation pattern, and through a variety of treatments (e.g., sidewalk widening, landscaping, traffic calming, and pedestrian-oriented features) is enhanced for pedestrian circulation and open space use. Though not explicitly stated in the code, a designated Green Street may be considered incompatible with layover sites. In anticipation of this, Metro has not identified any new potential layover spaces on designated Green Streets in the study area. However, many of Metro's existing layover sites (as indicated in Figure 5) are located on the Blanchard and Bell Green Streets. At this time, the likely impact that this will have on these existing layover sites is not clear.

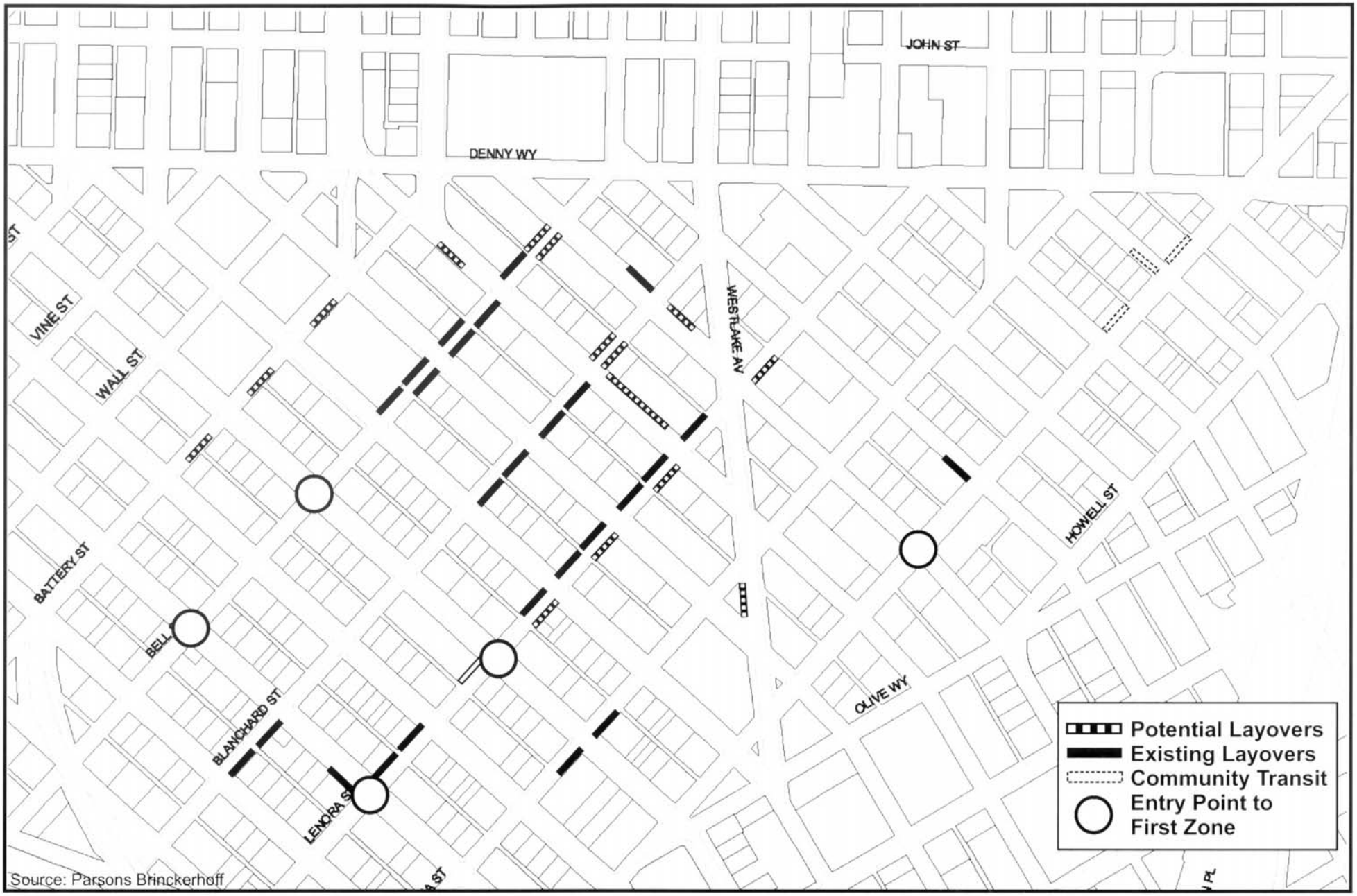


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Figure 5
Potential Future On-Street Layovers

II. ALTERNATIVE 4 – NO ACTION CONDITIONS

A. Travel Characteristics

The City of Seattle's travel demand forecasting model projects that by 2020 the Downtown area will serve as an origin and/or a destination for about 28 percent of daily person trips in the City of Seattle, which is slightly higher than the 26 percent estimated today. As shown in Table 11, on an average weekday, roughly 1,285,000 person trips are expected to have an origin and/or a destination within the Downtown area. This is 58 percent greater than today's estimate.

Mode share information from the Puget Sound Regional Council's (PSRC) travel demand model projects that of the Downtown-oriented trips, about 33 percent will be made by transit in 2020 (an increase from the 20 percent estimated today). In absolute numbers of daily transit trips to and from downtown Seattle, this represents a 160 percent increase. Assumed transit services in 2020 include Link Light Rail in its Locally Preferred Alternative alignment from Northgate to S. 200th Street in SeaTac.

Average weekday vehicle trips with an origin and/or destination within the Downtown area are expected to number about 645,900 in 2020, which is a 24 percent increase over current estimates. These vehicles are expected to be carrying approximately 861,000 persons, for an average auto occupancy of 1.33 persons per vehicle (approximately a six percent increase over today's estimate of 1.26).

To summarize, PSRC projections indicate a significant increase in overall daily trips to and from the Downtown area (58 percent), a substantial increase in transit ridership (160 percent), a small increase (6 percent) in average automobile occupancy (reflecting an increase in carpooling), a moderate increase in automobile vehicle trips (24 percent), and a decrease in the automobile mode share of (i.e., percentage of total) trips being made to downtown Seattle.

Table 11
Comparison of Travel Characteristics

	Existing Condition	2020 Condition	% Change to Year 2020
Average person-trips/weekday to/from Downtown	815,000	1,285,000	58%
Average vehicle trips/weekday to/from Downtown	519,400	645,900	24%
Percent of total daily person-trips made by transit	20%	33%	--
Daily person-trips made by transit	163,000	424,000	160%
Percent of total daily person-trips made by automobile	80%	67%	--
Daily person-trips made by automobile	652,000	861,000	32%
Average auto occupancy	1.26 persons	1.33 persons	6%

A view of travel patterns, including both through and local trips within and through the Downtown area, can be seen by examining travel volumes across imaginary lines called screenlines. In examining screenline volumes, it is more useful to look at peak-period patterns than daily totals. Screenline volumes and volume-to-capacity (v/c) ratios were calculated for the year 2020 Alternative 4 – No Action conditions for the same nine screenlines for which existing volumes were developed. Year 2020 AM and PM peak-hour traffic forecasts were developed based on forecasts from the City of Seattle's travel demand forecasting model. Traffic growth rates were obtained from the model and applied to actual ground counts in order to develop the future volumes used for analysis.

Table 12 shows year 2020 peak-hour traffic volumes and v/c ratios across these screenlines, for the AM and PM peak hour. The volumes shown are the summation of volumes on all individual streets crossing the screenline, and are shown in comparison to existing volumes and v/c ratios. Figures 6 and 7 portray these results graphically on a study area map.

Several patterns can be discerned from looking at the comparison of screenline volumes. As is the existing case, Screenline 7 east of Sixth Avenue has the highest volume. This indicates that the larger share of traffic oriented to downtown Seattle is expected to continue to arrive and depart via I-5 (i.e., across Screenline 7, which captures traffic heading to and from the I-5 ramps). Screenline 2, north of Seneca, capturing traffic using the main north/south arterials through the heart of Downtown, also shows a relatively high volume, particularly in the PM peak hour. Additionally, although Screenline 3 south of Blanchard Street continues to register a high volume, Screenline 6 east of Ninth is projected to grow considerably by the year 2020, to capture a proportionately larger share of the traffic entering/exiting Downtown to/from the north.

Table 12
Existing and 2020 No Action Peak Hour Traffic Volumes and Volume/Capacity Ratios Across Screenlines

Screenline	Map Key	AM Peak Hour					PM Peak Hour				
		Existing		2020 No Action			Existing		2020 No Action		
		Volume	V/C Ratio	Volume	V/C Ratio	% Vol Change	Volume	V/C Ratio	Volume	V/C Ratio	% Vol Change
South Screenline: North of S. King St., First Ave. S. to Sixth Ave. S.	1										
Northbound Total		3,360	0.70	2,920	0.61	-13.1	2,620	0.55	2,570	0.54	-1.9
Southbound Total		1,800	0.33	1,340	0.25	-25.6	2,800	0.52	2,720	0.50	-2.9
Central Screenline: North of Seneca St., Western Ave. to 6th Ave.	2										
Northbound Total		5,140	0.66	4,950	0.63	-3.7	5,350	0.69	6,220	0.80	16.3
Southbound Total		3,870	0.59	3,760	0.57	-2.8	4,590	0.70	5,450	0.83	18.7
North Screenline: South of Blanchard St., Elliott Ave. to 9th Ave.	3										
Northbound Total		2,610	0.26	2,490	0.24	-4.6	4,950	0.48	5,320	0.52	7.5
Southbound Total		3,890	0.38	4,100	0.40	5.4	3,090	0.30	3,970	0.39	28.5
West Screenline 1: East of First Ave., S. Jackson St. to Pine St.	4										
Westbound Total		2,960	0.31	2,560	0.27	-13.5	3,970	0.55	3,520	0.37	-11.3
Eastbound Total		2,880	0.27	2,820	0.26	-2.1	3,380	0.52	3,460	0.32	2.4
West Screenline 2: East of First Ave., Stewart St. to Blanchard St.	5										
Westbound Total		560	0.23	900	0.38	60.7	820	0.34	1,020	0.42	24.4
Eastbound Total		470	0.26	610	0.34	29.8	640	0.35	910	0.51	42.2

Table 12 (continued)
Existing and 2020 No Action Peak Hour Traffic Volumes and Volume/Capacity Ratios Across Screenlines

Screenline	Map Key	AM Peak Hour					PM Peak Hour				
		Existing		2020 No Action			Existing		2020 No Action		
		Volume	V/C Ratio	Volume	V/C Ratio	% Vol Change	Volume	V/C Ratio	Volume	V/C Ratio	% Vol Change
East Screenline 1: East of Ninth Ave., Lenora St. to Pike St.	6										
Westbound Total		3,190	0.44	3,640	0.51	14.1	2,020	0.28	3,780	0.53	87.1
Eastbound Total		1,760	0.27	4,380	0.66	148.9	3,680	0.56	5,830	0.88	58.4
East Screenline 2: East of Sixth Ave., Union St. to Jefferson St.	7										
Westbound Total		6,470	0.67	6,740	0.70	4.2	4,640	0.48	5,600	0.58	20.7
Eastbound Total		6,090	0.63	6,250	0.65	2.6	7,690	0.80	8,970	0.93	16.6
East Screenline 3: East of Minor Ave., Denny Way to Olive St.	8										
Westbound Total		2,930	0.81	3,380	0.94	15.4	2,150	0.60	3,360	0.93	56.3
Eastbound Total		1,980	0.47	4,280	1.02	116.2	3,320	0.79	4,680	1.11	41.0
East Screenline 4: West of 6th Ave. Yesler Way to S. Jackson St.	9	1,050	0.35	860	0.29	-18.1	1,180	0.39	810	0.27	-31.4
Westbound Total		750	0.25	650	0.22	-13.3	1,140	0.38	1,100	0.37	-3.5
Eastbound Total											
Grand Totals		**57,700**		**65,470**		**13.5**	**63,370**		**76,580**		**20.8**

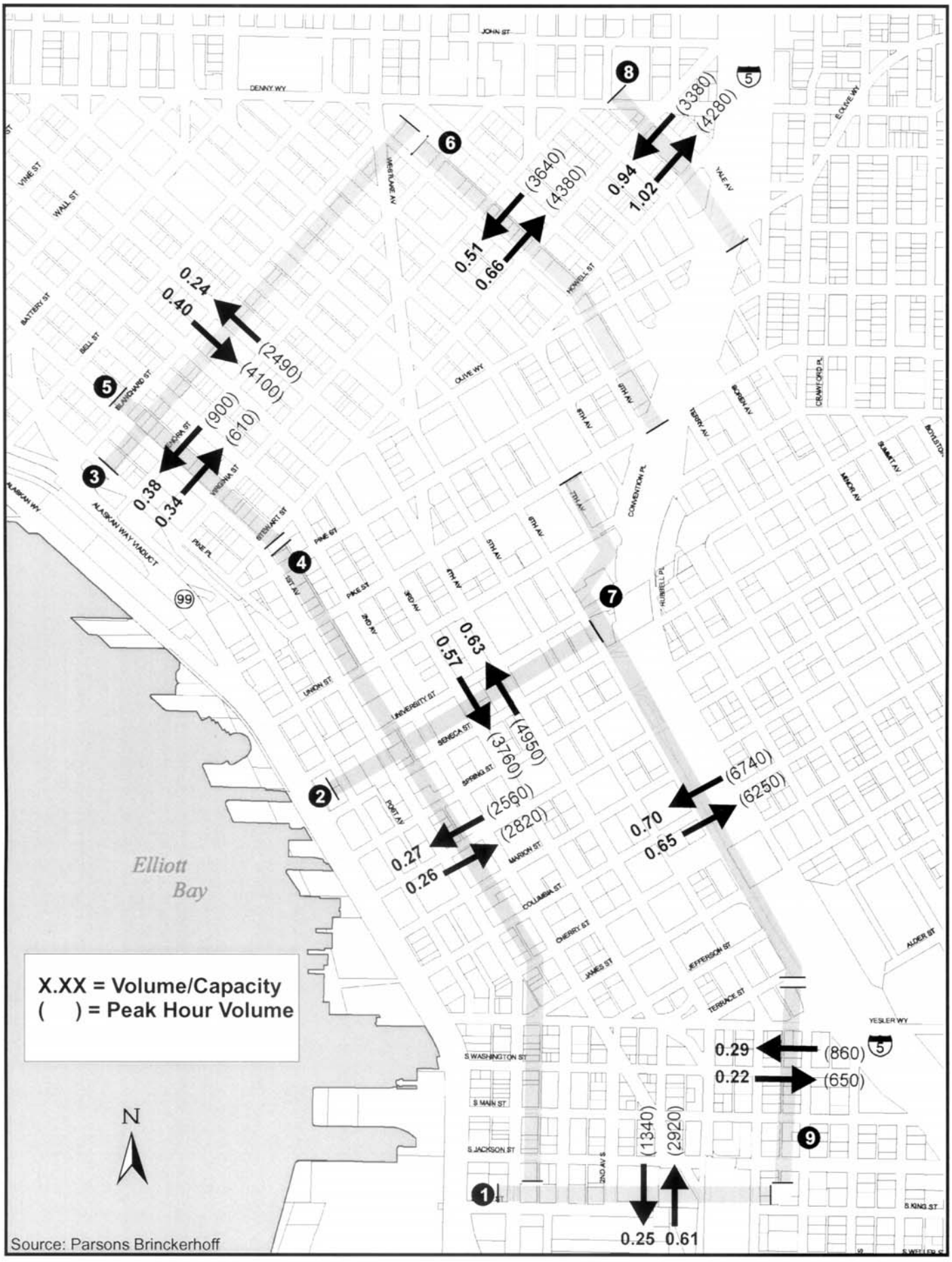

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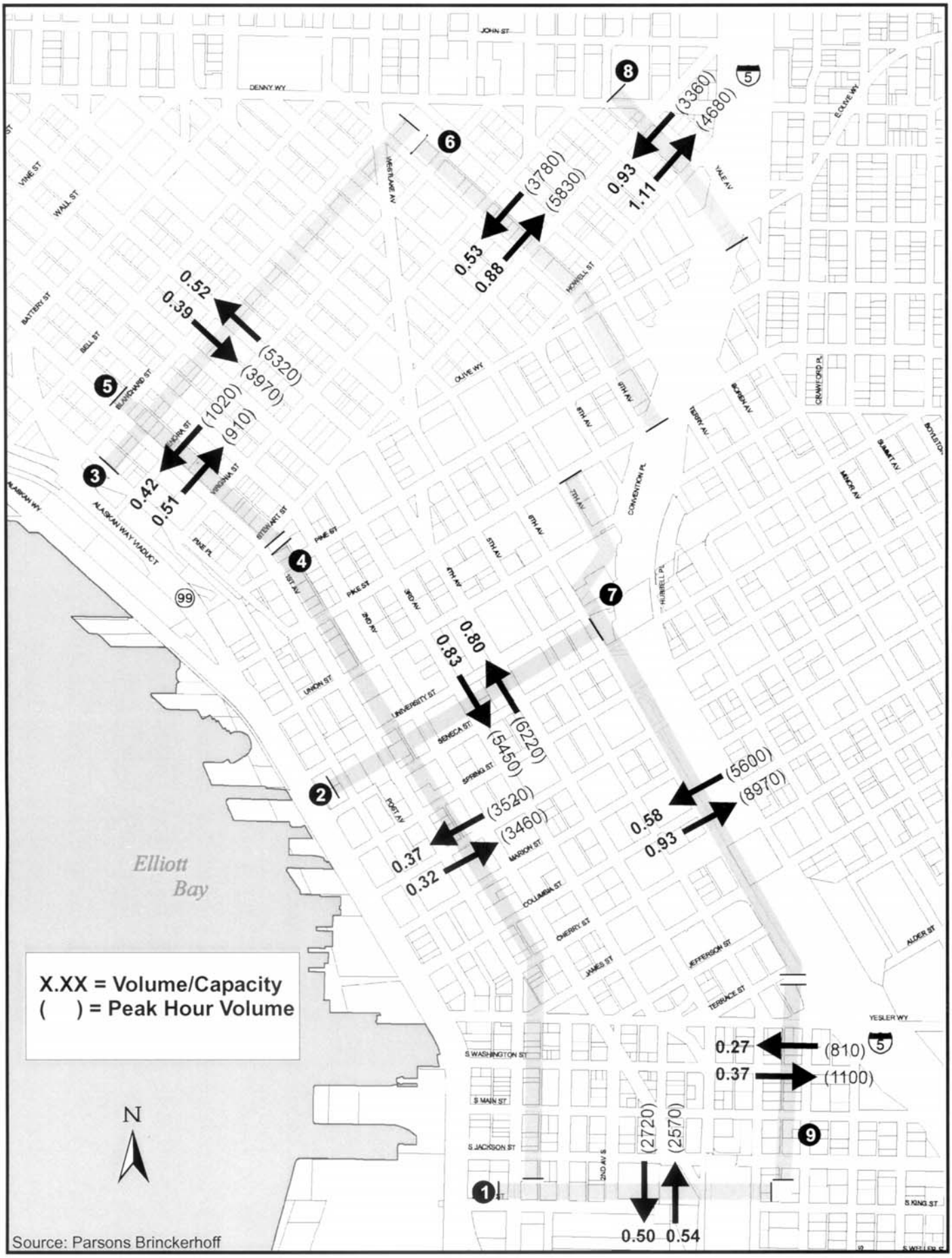
Figure 6
Year 2020 No Action Screenline Volumes and V/C Ratios - AM Peak Hour



Downtown Height & Density EIS

Figure 7
Year 2020 No Action Screenline Volumes and V/C Ratios
PM Peak Hour

On an aggregate basis, volumes across all screenlines are projected to increase by 9.4 percent in the AM peak hour, and by more than twice that amount (19.4 percent) in the PM peak hour. This overall increase is generally consistent with overall regional growth. However, some individual screenlines are shown to experience much more significant growth, while others are actually projected to decrease between current conditions and the year 2020. Those showing large projected increases are Screenline 6, east of 9th Avenue (+62.0 percent AM, +68.9 percent PM), Screenline 8, east of Minor Avenue (+56.2 percent AM, +47.0 percent PM), and Screenline 5, east of First Avenue – north segment (+46.6 percent AM, 33.1 percent PM). Screenlines for which the travel demand model is forecasting a decrease in peak-hour volumes of five percent or greater include Screenline 1, north of King Street (-17.4 percent AM), Screenline 4, east of First Avenue – south segment (-7.9 percent AM, -5.0 percent PM), and Screenline 9, west of Sixth Avenue (-16.1 percent AM, -18.0 percent PM). The decreases across these screenlines may be attributable to the addition of the SR 519 connection between I-5 and the Alaskan Way viaduct by the year 2020. This facility may divert future traffic around the study area screenlines in the south part of Downtown.

Other notable patterns in the year 2020 include the fact that for the majority of screenlines, volumes in the inbound direction are projected to continue to be higher in the AM than in the PM, and vice-versa for volumes in the outbound direction. However, the AM peak-hour directional split is anticipated to even out in the future, with only 52 percent of the total AM peak-hour screenline volume oriented inbound in the year 2020 (compared to the 56 percent observed today). This is likely due to the increase in residential units in the study area and an associated disproportionate increase in AM outbound traffic as compared to inbound traffic. More specifically, the two screenlines in the northeast portion of the study area, Screenline 6, east of Ninth Avenue, and Screenline 8, east of Minor Avenue, show a dramatic increase in outbound traffic in the AM peak hour at 148.9 percent and 116.2 percent respectively. The inbound/outbound directional split across all screenlines (shown in Table 13) is expected to stay about the same as is observed today in the PM peak hour, with 58 percent outbound and 42 percent inbound. Another observation is that when summing up volumes across all screenlines, PM peak-hour traffic is projected to be over 22 percent higher than AM peak-hour traffic, which is significantly greater than the 12 percent difference seen today. This is consistent with the fact that from today to the year 2020, PM peak-hour traffic is expected to grow by a larger amount (20.8 percent) than AM peak-hour traffic (13.5 percent).

Table 13
Percent of Inbound/Outbound Traffic
Across Study Area Screenlines

	Existing		Year 2020	
	AM	PM	AM	PM
Inbound	57%	41%	52%	42%
Outbound	43%	59%	48%	58%

With respect to v/c ratios, although only two screenlines had ratios of 0.80 or higher currently (indicating potentially congested operations), four screenlines are anticipated to experience these levels by the year 2020. These include:

Screenline 2, north of Seneca Street – northbound and southbound in the PM peak hour
Screenline 6, east of Ninth Avenue – eastbound in the PM peak hour
Screenline 7, east of Sixth Avenue – eastbound in the PM peak hour
Screenline 8, north of Minor Avenue – westbound and eastbound in both the AM and PM peak hours

These results are consistent with the expected growth in traffic, as shown by the screenline volumes and are consistent with the findings that show that a large portion of traffic destined for the study area is oriented either to and from the east (i.e., I-5), or the north via surface streets, and the Stewart/Olive/Howell Street corridors in particular. None of the screenlines analyzed are projected to exceed a v/c ratio of 1.2. Volumes across Screenline 8, east of Minor Avenue, however, are expected to result in a relatively high level of congestion in the eastbound direction in both the AM and PM peak hours, with a projected v/c ratio of 1.01 in the AM and 1.11 in the PM peak hour.

B. Traffic Circulation

Current Operating Conditions

To assess future operating conditions in the study area, this study focuses on two arterial corridors— the Stewart/Howell/Olive Way corridor, and the Denny Way corridor. Within those corridors, a total of 38 intersections were analyzed—26 in the Stewart/Howell/Olive corridor, and 12 along Denny Way. Year 2020 AM and PM peak-hour traffic forecasts were based on forecasts from the City of Seattle's travel demand forecasting model. Traffic growth rates were obtained from the model and applied to actual ground counts in order to develop the future volumes used for analysis. The intersection analysis was conducted using the micro-simulation model Synchro. This model simulates traffic operations both at a corridor and intersection level. The advantage of using the simulation model is that it can indicate how operations at one intersection can impact those at adjacent intersections (e.g., due to queue back-ups or signal phasings and/or timings). Such an analysis provides a more comprehensive picture of operations in the corridor as opposed to analyzing intersection operations in isolation. In analyzing the simulation model results it is important to keep in mind that signal phasings and timings were held constant between the existing condition and year 2020 on the Stewart/Howell/Olive corridors. This was done because intersection operations in these corridors proved to be highly sensitive to optimization and it proved difficult to determine if the change in operations was due to the land use alternative impacts, or signal timing manipulations. Hence, in order to have a consistent base upon which to compare the impacts of the alternatives in these corridors, the signal timings were held constant across all alternatives. Note however, that it is likely that corridor levels of service shown here could be improved upon through optimizing the signal network.

Table 14 shows projected year 2020 peak-hour levels of service (LOS) and queuing impacts, compared to existing LOS and queuing impacts for intersections in the study area corridors. Year 2020 AM and PM peak-hour intersection LOS results for Alternative 4 – No Action are also shown graphically on Figure 8.

AM Peak Hour

The analysis indicates that in the AM peak hour for the corridors analyzed, operations are expected to significantly worsen by the year 2020. Eleven of the 38 intersections analyzed are projected to experience operating conditions of LOS E or worse, as compared to only two under current condition. These include two intersections along Stewart Street, two on Howell Street, three on Olive Way, and four along Denny Way. All but two of these 11 intersections are projected to be operating at LOS F by 2020.

Note that although other intersections are expected to operate at LOS D or better by 2020, many of them are still projected to experience queuing problems on one or more approaches such that queues back up to affect operations at upstream intersections. This is particularly evident along Stewart Street in the westbound, or inbound, direction, where 8 of the 12 intersections analyzed are expected to experience these conditions, and along Denny Way in the eastbound direction where all 12 intersections are projected to experience significant queuing problems. These results indicate that these directions for these two corridors in particular will experience significant congestion by the year 2020. Another notable observation is that along Howell Street and Olive Way, nearly half of the intersections in the AM peak hour are projected to experience queuing problems in the eastbound (outbound) direction. This is a noticeable increase from existing conditions and indicates that by 2020, outbound traffic from Downtown is expected to increase significantly.

PM Peak Hour

As is the case with existing operations, PM peak-hour conditions are projected to be generally worse than AM peak conditions in the year 2020. Additionally, year 2020 PM peak-hour conditions as compared to existing PM peak-hour conditions are projected to be much worse. Along Stewart Street, of the 12 intersections analyzed, five are projected to be operating at LOS E or F in the year 2020 PM peak hour, as compared to only one in the existing PM peak.

Similarly for the Olive/Howell corridors, of the 14 intersections analyzed, only two were LOS E or worse under existing conditions, while five are projected to be operating at these levels by the year 2020. The Denny Street corridor shows an even larger change, with seven intersections forecasted to be operating at LOS E or worse in 2020 (up from two today). Other observations include that fact that the biggest change in operating conditions is projected to be at the northeastern ends of the Stewart/Howell/Olive corridors. The Denny Way corridor sees significant increases in congestion throughout, with a slightly higher predominance toward the western end (between Dexter Avenue and Broad Street all but two intersections are projected to be operating at LOS E or F). Overall, 17 of the 38 intersections analyzed (45 percent) are projected to be operating at LOS E or worse in the PM peak hour by the year 2020 (up from only five today); and all but two of these intersections are expected to be operating at LOS F.

The queuing analysis for the PM peak hour indicates that by the year 2020 most of the corridors analyzed are expected to experience corridor-wide congestion. Eight of the 12 intersections analyzed along Stewart Street are expected to experience queues in the westbound direction that back up into adjacent intersections. This is a dramatic increase over existing PM peak-hour conditions, in which only two intersections are calculated to be westbound queuing problems. Also significant is that along Denny Way, every intersection in the eastbound direction, and over half of them in the westbound direction are expected to experience queuing problems. While this is not dramatically different from today's conditions, it does indicate that current congested conditions will be exacerbated in the future.

Table 14
Existing and 2020 No Action
Peak Hour Intersection Levels of Service and Queuing Impacts

Intersection	AM Peak Hour				PM Peak Hour			
	Existing Conditions		2020 No-Action		Existing Conditions		2020 No-Action	
	LOS	*Queuing Impacts*	*LOS*	*Queuing Impacts*	*LOS*	*Queuing Impacts*	*LOS*	*Queuing Impacts*
Stewart & 3rd Ave	B	---	B	---	B	---	B	---
Stewart & 4th Ave	A	WB	B	NB/WB	A	---	A	NB/WB
Stewart & 5th Ave	F	SB/WB	F	SB/WB	B	---	C	SB/WB
Stewart & Westlake	B	WB	B	WB	A	---	B	---
Stewart & 6th Ave	C	WB	C	WB	B	---	C	WB
Stewart & 7th Ave	B	---	B	SB/WB	A	---	F	SB/WB
Stewart & 8th Ave	A	---	A	---	B	---	B	---
Stewart & 9th Ave	A	---	A	---	A	---	F	SB/WB
Stewart & Terry	A	WB	B	WB	A	---	A	---
Stewart & Boren	B	SB	D	SB/WB	B	SB	F	SB/WB
Stewart & Minor	B	---	B	---	D	SB/WB	F	SB/WB
Stewart & Yale	B	SB/WB	F	SB/WB	F	SB/WB	F	SB/WB
Howell & Yale	C	SB/EB/WB	F	SB/EB/WB	D	SB/EB	C	SB/EB
Howell & Minor	C	WB	C	WB	F	SB	F	SB/WB
Howell & Boren	D	NB/WB	E	NB/EB/WB	D	NB/EB	E	---
Howell & Terry	A	---	B	---	A	---	A	---
Howell & 9th Ave	C	---	D	---	C	---	F	SB
Howell & 8th/Olive	B	---	C	EB	A	---	B	EB
Olive & Melrose	B	EB	F	EB/NB	C	EB	F	EB/NB
Olive & Boren	D	NB	F	EB/NB	F	EB/NB/SB	F	EB/NB/SB
Olive & Terry	A	---	E	EB	A	---	D	EB
Olive & 9th Ave	A	---	D	EB	B	---	C	EB/SB
Olive & 7th Ave	B	---	C	---	A	---	D	SB
Olive & 6th Ave	B	---	B	---	B	---	B	NB
Olive & 5th/Westlake	D	SB	C	SB	C	---	D	EB/SB
Olive & 4th Ave	B	---	B	---	B	---	B	---

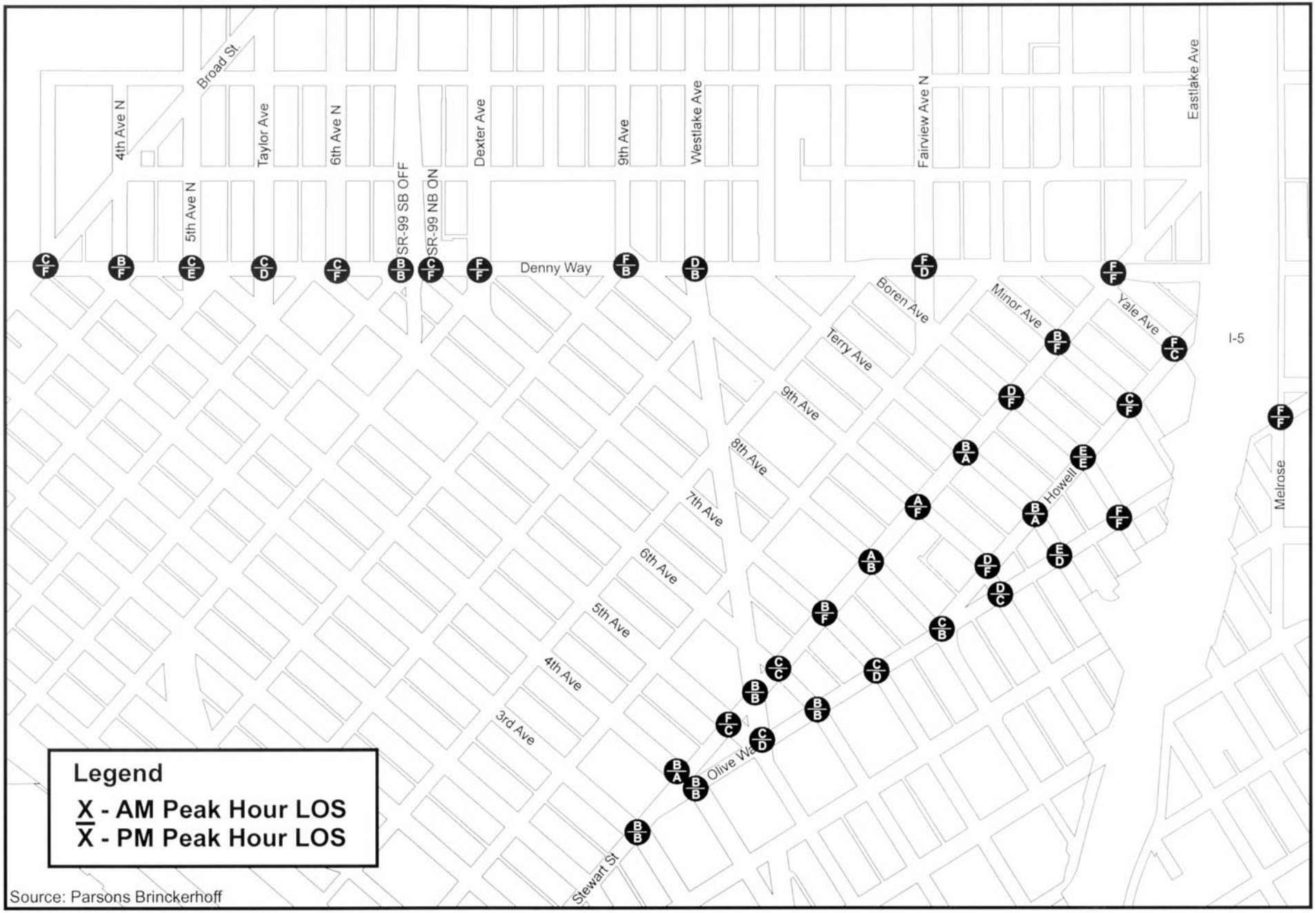
* Direction(s) indicated are for those approaches where queues from the specified intersection are expected to back up and affect operations at adjacent intersections.

Table 14 (continued)

Existing and 2020 No Action
Peak Hour Intersection Levels of Service and Queuing Impacts

	AM Peak Hour				PM Peak Hour			
	Existing Conditions		2020 No-Action		Existing Conditions		2020 No-Action	
Intersection	*LOS*	*Queuing Impacts**	*LOS*	*Queuing Impacts**	*LOS*	*Queuing Impacts**	*LOS*	*Queuing Impacts**
Denny & Stewart	F	EB/WB/SW	F	EB/WB/SW	F	EB/SW	F	EB/WB/SW
Denny & Fairview	D	EB/WB/NB	F	EB/WB/NB	C	EB/WB/NB	D	EB/WB/NB
Denny & Westlake	A	---	D	EB	C	EB/NB	B	EB/NB
Denny & 9th Ave	A	EB/SB	F	EB/SB	B	EB/SB	B	EB/SB
Denny & Dexter	D	EB/WB	F	EB	D	EB/WB	F	EB/WB/NB
Denny & Aurora NB	B	EB/WB	C	EB/WB	C	EB/WB/NB	F	EB/WB/NB
Denny & Aurora SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB
Denny & 6th Ave	B	WB	C	EB/WB/NB	E	EB/WB/NB	F	EB/NB
Denny & Taylor	B	WB	C	EB	B	---	D	EB
Denny & 5th Ave	B	---	C	EB	B	---	E	EB/WB
Denny & 4th Ave	A	---	B	EB	B	---	F	EB
Denny & Broad	B	---	C	EB	B	WB	F	EB/WB/NE

* Direction(s) indicated are for those approaches where queues from the specified intersection are expected to back up and affect operations at adjacent intersections.



Source: Parsons Brinckerhoff

Seattle Height & Density EIS

Figure 8
Year 2020 No Action
AM & PM Peak Hour Intersection Levels of Service

Corridor Travel Time Summaries

Table 15 shows projected year 2020 average AM and PM peak-hour travel time summaries for the corridors studied, compared to those tabulated for existing conditions. Travel time over a particular route is frequently used as a measure of effectiveness for comparing transportation alternatives. These figures were developed based on output from the Synchro micro-simulation model.

Table 15
Existing and 2020 No Action Peak Hour Corridor Travel Time Summaries

Corridor	AM Peak Hour (minutes)			PM Peak Hour (minutes)		
	Existing	2020	% Change	Existing	2020	% Change
Denny Way Eastbound	5.5	12.7	133%	5.9	19.7	232%
Denny Way Westbound	5.9	14.7	147%	6.3	10.6	68%
Olive Way Eastbound	3.8	6.6	75%	3.4	5.3	55%
Stewart Street Westbound	4.0	4.4	11%	8.5	11.9	40%

Assumptions:
* Stewart Street corridor evaluated from Yale Ave to 3rd Ave
* Olive Way corridor evaluated from 3rd Ave to Boren Ave
* Denny Corridor (both directions) evaluated from Broad St to Stewart St
* Average travel speed of 20 mph is assumed from all arterial segments

The results indicate that all corridors are expected to experience a significant increase in travel time by the 2020. Of particular note is the Denny Way corridor, which is anticipated to experience travel time increases of between 68 and 232 percent, depending on direction and time of day. This represents from four to fourteen minutes of additional delay through the corridor. Stewart Street in the westbound direction in the PM peak hour is expected to experience a travel time increase of 40 percent, as compared to only 11 percent in the AM peak hour. This is likely due to a combination of a relatively high projected increase in traffic on Stewart Street in the PM peak hour (it nearly doubles), and the fact that signal phasings and timings along the corridor were held constant (see note above) and were not optimized for future conditions. However, even with optimized signal operations, the increased congestion along Stewart Street by the year 2020 is anticipated to be considerable and will significantly affect corridor travel times. Travel times along Olive Way eastbound in both the AM and PM peak hours are anticipated to increase at slightly higher rates than along Stewart Street in the PM peak hour.

C. Transit Service

As noted in the preceding Travel Characteristics section, daily transit trips to and from downtown Seattle are forecast to increase by 160 percent compared to today, with transit's share of total Downtown oriented trips increasing from 20 percent to 33 percent. Assumed transit facilities in 2020 include Link Light Rail in its Locally Preferred Alternative alignment from Northgate to S. 200th Street in SeaTac. Light Rail stations in Downtown would include Westlake, University Street, Pioneer Square and International District. In addition, some bus routes would use the Downtown Seattle transit tunnel jointly with light rail, and would provide service at the Convention Place station. With joint bus/rail operations in the tunnel, bus volumes on surface streets would remain at or below current levels.

North of Seneca Street Screenline

In the 2020 No Action Alternative (Alternative 4), AM traffic conditions can be categorized as similar or slightly improved over existing conditions, as the northbound v/c ratio decreases from 0.66 to 0.63 and the southbound v/c ratio from 0.59 to 0.57 (see Table 12). However, PM peak-hour traffic conditions are projected to worsen, as indicated from a v/c ratio change of 0.69 to 0.80 in the northbound direction and 0.70 to 0.83 southbound (also shown in Table 12). In the PM peak hour, Second Avenue, Third Avenue, and Fourth Avenue carry high volumes of buses in the PM peak hour and are expected to experience the largest increases in cumulative transit delay.

Stewart/Olive Corridors

By 2020, significant changes are projected to occur in traffic operations, which will impact transit operations through the Stewart Street and Olive Way corridors and increase cumulative transit times by 43 percent (see Table 16). AM and PM peak-hour travel times are expected to increase by about the same amount (40 percent and 45 percent respectively) and will have similar cumulative impacts on the corridors as a whole.

Table 16
Comparison of Existing and 2020 No Action
Cumulative Transit Travel Time - Stewart/Olive Corridors

Peak Hour	Total Bus-Minutes		% Change
	Existing	2020 No-Action	
AM	572	801	40%
PM	651	942	45%
AM and PM	1223	1743	43%

Denny Way Screenline

Assuming current levels of transit service in the year 2020, Alternative 4 – No Action is projected to experience significant increases in peak-hour delay for transit service crossing Denny Way. As shown in Table 17, the total minutes of delay for buses increases from 29 minutes to 63 minutes in the AM peak hours, and from 40 minutes to 108 minutes in the PM peak hour, for an overall increase in cumulative bus delay of 146 percent. Under Alternative 4 – No Action, Dexter Avenue and Aurora Avenue are expected to experience increasingly high levels of delay, particularly in the PM peak hour. Fairview Avenue is projected to experience a large increase in delay in the AM peak hour, and Fifth Avenue in the PM peak hour as compared to existing conditions.

Table 17
Comparison of Existing and 2020 No Action
Cumulative Bus Delay in Minutes Crossing Denny Way

Crossing	Bus-Minutes of Delay				% Change	
	Existing		2020 No-Action			
	AM	PM	AM	PM	AM	PM
Fourth Avenue	0.5	2.9	0.9	13.6	91%	368%
Fifth Avenue	6.0	6.1	8.8	27.4	46%	348%
Aurora Avenue	9.1	11.9	11.0	31.0	22%	161%
Dexter Avenue	6.4	11.7	15.0	26.7	134%	129%
Ninth Avenue	0.9	0.5	8.4	0.7	809%	24%
Westlake Avenue	0.6	2.1	3.5	1.6	496%	-25%
Fairview Avenue	5.7	5.2	15.0	7.4	165%	42%
Totals	29	40	63	108	115%	168%
AM and PM Totals	70		171		146%	

Layover

By the year 2020, some changes in the availability of existing and potential layover spaces may occur under Alternative 4 – No Action. The forecasted redevelopment of the area identifies specific blocks that may be redeveloped, as illustrated in Figure 5. For the purposes of this analysis, it is assumed that any site indicated for redevelopment will displace the existing or potential layover location and that no adjustment will be made to reflect situations in which layover space could be retained. This approach is conservative, because it reflects the condition of highest potential impact. Under Alternative 4 – No Action, development on eight blocks within the study area could potentially displace layover spaces, for a total displacement of ten existing Metro locations and seven potential Metro locations. No Community Transit layover spaces are lost under Alternative 4 – No Action. The number of existing and potential spaces lost is roughly equal under Alternative 4 – No Action, suggesting that the most desirable alternative sites have already been displaced under this scenario and that identifying additional replacement sites will be challenging. The need to be in proximity to the zone entry points and the designation of Green Streets in the study area may limit the number of potential layover spaces.

III. IMPACTS

A. Travel Characteristics

Year 2020 AM and PM peak-hour traffic forecasts were developed for the three land-use zoning alternatives using the City of Seattle's EMME/2 travel demand forecasting model. The general process involved inputting the changed land use conditions for each alternative into the trip generation module of the model, in order to obtain the change in number and type of overall trips as compared to Alternative 4 – No Action. These trips were then distributed and assigned to the model street network for each alternative. Peak-hour analysis volumes were then developed using growth rates from the model runs for each alternative and applying them to existing traffic counts.

Table 18 shows projected year 2020 screenline volumes for all alternatives as compared to Alternative 4 – No Action for the AM and PM peak hours. Note that while the No Action Alternative showed substantial changes from existing conditions, results for the three land-use zoning alternatives showed very little difference from Alternative 4 – No Action. Given the nature of travel demand forecasting, differences of five percent or less are generally considered to be insignificant, since most models cannot forecast beyond this level of accuracy. Hence, most of the differences indicated between the three land-use zoning alternatives and the No Action Alternative can be considered insignificant. There are a few screenlines that exhibit changes of greater than five percent for some alternatives. These are discussed in the following assessment of screenline impacts by alternative.

Table 19 shows projected year 2020 screenline volume-to-capacity (v/c) ratios for all alternatives as compared to Alternative 4 – No Action for the AM and PM peak hours. Since the capacities of the streets are identical for all alternatives, including the No Action, the relative differences between v/c ratios are the same as between alternative screenline volumes. Of particular note is whether any of the alternatives are projected to cause a change resulting in a screenline v/c ratio exceeding 1.20, which is the City's maximum arterial level of service standard for some areas of Downtown. Observations on v/c ratios are included below in the travel characteristic discussion by alternative. Figures 9 through 14 graphically show screenline volumes and v/c ratios for the three alternatives for the AM and PM peak hours.

Alternative 1

Projected screenline volume totals for Alternative 1 show very minor differences from Alternative 4 – No Action for all screenlines except the following:

> Screenline 8, east of Minor Avenue, eastbound in the PM peak hour shows a 7.9 percent increase in volumes compared to the 2020 No Action condition.
> Screenline 9, west of Sixth Avenue (between Yesler and S. Jackson St), westbound in the AM peak hour shows an 8.1 percent decrease in volumes.

The increase across Screenline 8 is in the outbound direction in the PM peak hour, and reflects an increase in commercial development in the northeast section of the Downtown area for Alternative 1 as compared to Alternative 4 – No Action. The decrease indicated across Screenline 9 is in the inbound direction in the AM peak hour and may reflect differences in anticipated amounts of growth in the commercial core, and as a consequence, more trips oriented to the northern portion of Downtown.

With respect to inbound/outbound directional patterns, Alternative 1 is projected to be similar to Alternative 4 – No Action, with the following directional splits: 52 percent of AM peak-hour traffic is inbound, and 58 percent of PM peak-hour traffic is outbound. PM peak-hour traffic volumes totaled across screenlines are roughly 23 percent larger than AM peak-hour volumes, which is similar to the No Action Alternative.

Regarding screenline v/c ratios, Alternative 1 is very similar to Alternative 4 – No Action, with the following four screenlines anticipated to experience ratios of 0.80 or higher, indicating potentially congested operations:

Screenline 2, north of Seneca Street – northbound and southbound in the PM peak hour
Screenline 6, east of Ninth Avenue – eastbound in the PM peak hour
Screenline 7, east of Sixth Avenue - eastbound in the PM peak hour
Screenline 8, north of Minor Avenue - westbound and eastbound in both the AM and PM peak hours

Of particular note is that none of the screenlines analyzed are projected to exceed a v/c ratio of 1.20. Screenline 8, east of Minor Avenue, is expected to be right at a v/c level of 1.20 eastbound in the PM peak hour. It is also expected to experience a v/c ratio of 1.06 in the AM peak hour, reflecting relatively high congestion.

Alternative 2
Projected screenline volume totals for Alternative 2 also show very minor differences from Alternative 4 – No Action for all screenlines except the following:

Screenline 9, west of Sixth Avenue (between Yesler Way and S. Jackson St), westbound in the AM peak hour shows a 9.3 percent decrease in volumes.

As with Alternative 1, the decrease indicated across Screenline 9 is in the inbound direction in the AM peak hour. This may reflect differences in anticipated amounts of growth in the commercial core, and as a consequence, more trips oriented to the northern portion of Downtown.

With respect to inbound/outbound directional patterns, Alternative 2 is projected to be the same as Alternative 4 – No Action, with the following directional splits: 52 percent of AM peak-hour traffic is inbound, and 58 percent of PM peak-hour traffic is outbound. PM peak-hour traffic volumes totaled across screenlines are roughly 23 percent larger than AM peak-hour volumes, which is similar to the No Action Alternative.

Regarding screenline v/c ratios, Alternative 2 is also very similar to Alternative 4 – No Action, with the following four screenlines anticipated to experience ratios of 0.80 or higher, indicating potentially congested operations:

Screenline 2, north of Seneca Street – northbound and southbound in the PM peak hour
Screenline 6, east of Ninth Avenue – eastbound in the PM peak hour
Screenline 7, east of Sixth Avenue - eastbound in the PM peak hour
Screenline 8, north of Minor Avenue - westbound and eastbound in both the AM and PM peak hours

Of particular note is that none of the screenlines analyzed are projected to exceed a v/c ratio of 1.20. Screenline 8, east of Minor Avenue, is expected to have a v/c ratio of 1.02 in the AM peak hour and 1.13 in the PM peak hour, reflecting relatively congested conditions.

Table 18
2020 Peak Hour Traffic Volumes
Across Screenlines for All Alternatives

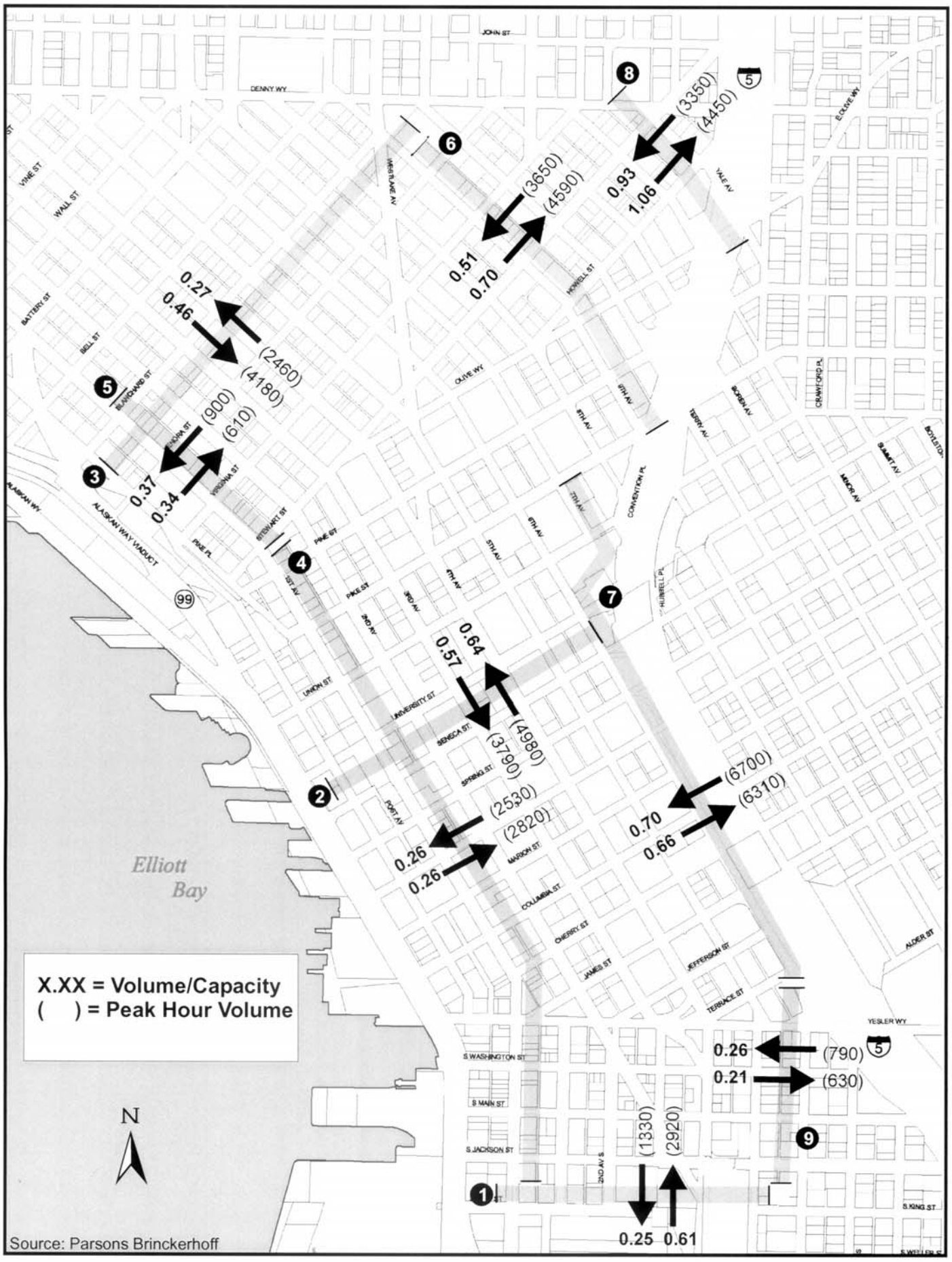
Screenline	Map Key	2020 No Action		Alternative 1				Alternative 2				Alternative 3			
		Volume		Volume		% Change from No Action		Volume		% Change from No Action		Volume		% Change from No Action	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
South Screenline: North of S. King St., First Ave. S. to Sixth Ave. S.	1														
Northbound Total		2920	2570	2920	2590	0.0%	0.8%	2930	2580	0.3%	0.4%	2910	2570	-0.3%	0.0%
Southbound Total		1340	2720	1330	2760	-0.7%	1.5%	1340	2720	0.0%	0.0%	1340	2760	0.0%	1.5%
Central Screenline: North of Seneca St., Western Ave. to Sixth Ave.	2														
Northbound Total		4950	6220	4980	6290	0.6%	1.1%	4940	6270	-0.2%	0.8%	4960	6230	0.2%	0.2%
Southbound Total		3760	5450	3790	5520	0.8%	1.3%	3810	5450	1.3%	0.0%	3780	5470	0.5%	0.4%
North Screenline: South of Blanchard St., Elliott Ave. to Ninth Ave.	3														
Northbound Total		2490	5320	2460	5410	-1.2%	1.7%	2450	5380	-1.6%	1.1%	2440	5310	-2.0%	-0.2%
Southbound Total		4100	3970	4180	4010	2.0%	1.0%	4130	3960	0.7%	-0.3%	4110	3950	0.2%	-0.5%
West Screenline 1: East of First Ave., S. Jackson St. to Pine St.	4														
Westbound Total		2560	3520	2530	3570	-1.2%	1.4%	2520	3550	-1.6%	0.9%	2550	3510	-0.4%	-0.3%
Eastbound Total		2820	3460	2820	3350	0.0%	-3.2%	2830	3380	0.4%	-2.3%	2840	3380	0.7%	-2.3%
West Screenline 2: East of First Ave., Stewart St. to Blanchard St.	5														
Westbound Total		900	1020	900	1050	0.0%	2.9%	870	1070	-3.3%	4.9%	880	1110	-2.2%	8.8%
Eastbound Total		610	910	610	910	0.0%	0.0%	580	890	-4.9%	-2.2%	580	880	-4.9%	-3.3%

Table 18 (continued)
2020 Peak Hour Traffic Volumes
Across Screenlines for All Alternatives

Screenline	Map Key	2020 No Build		Alternative 1				Alternative 2				Alternative 3			
		Volume		Volume		% Change from No Action		Volume		% Change from No Action		Volume		% Change from No Action	
		AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
East Screenline 1: East of Ninth Ave., Lenora St. to Pike St.	6														
Westbound Total		3640	3780	3650	3940	0.3%	4.2%	3550	3760	-2.5%	-0.5%	3790	3840	4.1%	1.6%
Eastbound Total		4380	5830	4590	5970	4.8%	2.4%	4500	5990	2.7%	2.7%	4430	5960	1.1%	2.2%
East Screenline 2: East of Sixth Ave., Union St. to Jefferson St.	7														
Westbound Total		6740	5600	6700	5620	-0.6%	0.4%	6740	5610	0.0%	0.2%	6750	5620	0.1%	0.4%
Eastbound Total		6250	8970	6310	8930	1.0%	-0.4%	6260	8930	0.2%	-0.4%	6280	8970	0.5%	0.0%
East Screenline 3: East of Minor Ave, Denny Way to Olive Way	8														
Westbound Total		3380	3360	3350	3240	-0.9%	-3.6%	3350	3250	-0.9%	-3.3%	3560	3680	5.3%	9.5%
Eastbound Total		4280	4680	4450	5050	4.0%	7.9%	4300	4740	0.5%	1.3%	4380	4680	2.3%	0.0%
East Screenline 2: West of Sixth Ave., Yesler Way to S. Jackson St.	9														
Westbound Total		860	810	790	820	-8.1%	1.2%	780	820	-9.3%	1.2%	790	820	-8.1%	1.2%
Eastbound Total		650	1100	630	1100	-3.1%	0.0%	640	1100	-1.5%	0.0%	640	1090	-1.5%	-0.9%

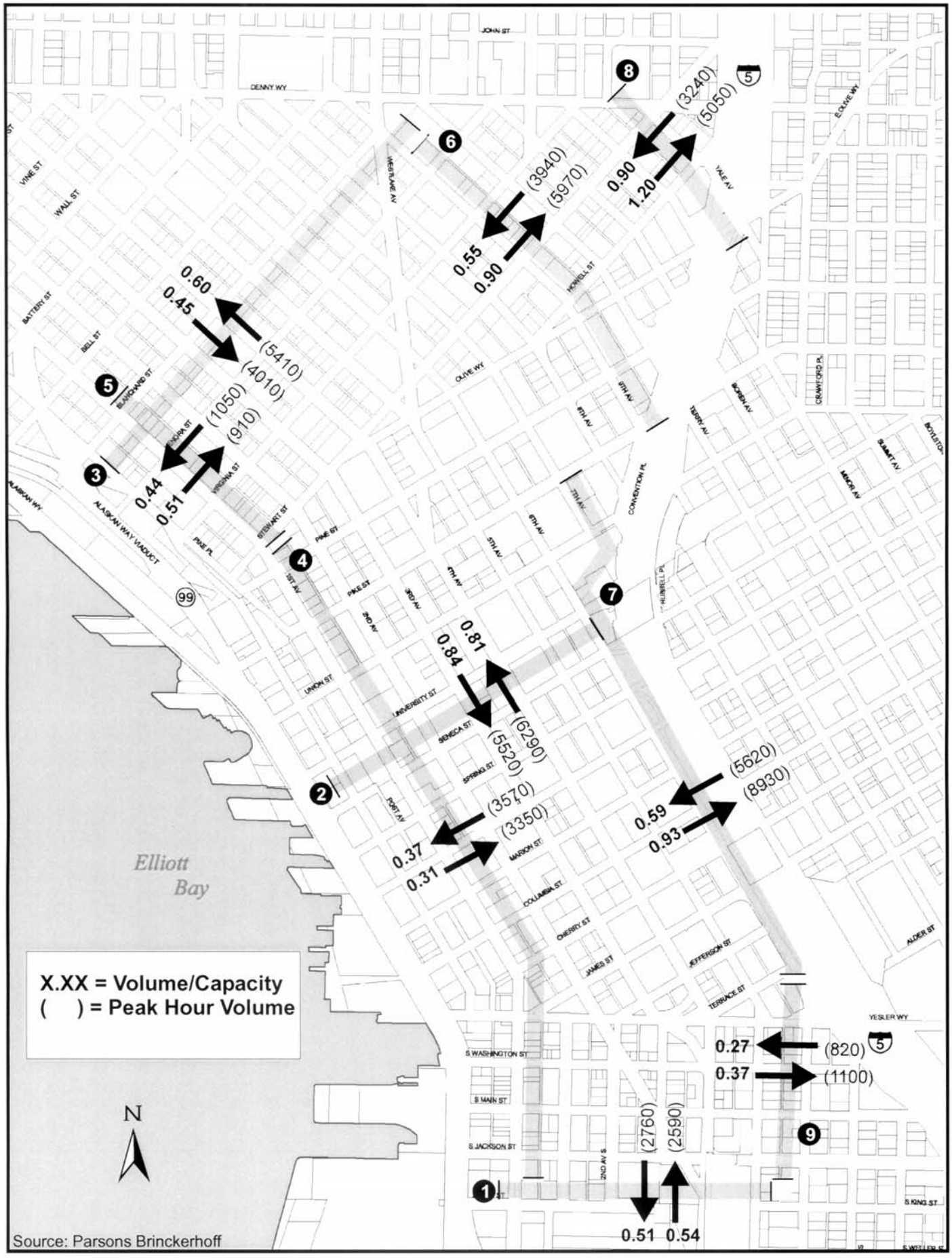
Table 19
2020 Peak Hour V/C Ratios
Across Screenlines for All Alternatives

Screenline	Map Key	V/C Ratios							
		2020 No Build		Alternative 1		Alternative 2		Alternative 3	
		AM	PM	AM	PM	AM	PM	AM	PM
South Screenline: North of S. King St., First Ave. S. to Sixth Ave. S.	1								
Northbound Total		0.61	0.54	0.61	0.54	0.61	0.54	0.61	0.53
Southbound Total		0.25	0.50	0.25	0.51	0.25	0.50	0.25	0.51
Total Both Directions		0.42	0.52	0.42	0.52	0.42	0.52	0.42	0.52
Central Screenline: North of Seneca St., Western Ave. to Sixth Ave.	2								
Northbound Total		0.63	0.80	0.64	0.81	0.63	0.80	0.64	0.80
Southbound Total		0.57	0.83	0.57	0.84	0.58	0.83	0.57	0.83
Total Both Directions		0.60	0.81	0.61	0.82	0.61	0.81	0.61	0.81
North Screenline: South of Blanchard St., Elliott Ave. to Ninth Ave.	3								
Northbound Total		0.28	0.59	0.27	0.60	0.27	0.60	0.27	0.59
Southbound Total		0.46	0.44	0.46	0.45	0.46	0.44	0.46	0.44
Total Both Directions		0.37	0.52	0.37	0.52	0.37	0.52	0.36	0.51
West Screenline 1: East of First Ave., S. Jackson St. to Pine St.	4								
Westbound Total		0.27	0.37	0.26	0.37	0.26	0.37	0.27	0.37
Eastbound Total		0.26	0.32	0.26	0.31	0.26	0.31	0.26	0.31
Total Both Directions		0.26	0.34	0.26	0.34	0.26	0.34	0.26	0.34
West Screenline 2: East of First Ave., Stewart St. to Blanchard St.	5								
Westbound Total		0.38	0.42	0.37	0.44	0.36	0.44	0.36	0.46
Eastbound Total		0.34	0.51	0.34	0.51	0.32	0.49	0.32	0.49
Total Both Directions		0.36	0.46	0.36	0.47	0.35	0.47	0.35	0.47
East Screenline 1: East of Ninth Ave., Lenora St. to Pike St.	6								
Westbound Total		0.51	0.53	0.51	0.55	0.49	0.52	0.53	0.53
Eastbound Total		0.66	0.88	0.70	0.90	0.68	0.91	0.67	0.90
Total Both Directions		0.58	0.70	0.60	0.72	0.58	0.71	0.60	0.71
East Screenline 2: East of Sixth Ave., Union St. to Jefferson St.	7								
Westbound Total		0.70	0.58	0.70	0.59	0.70	0.58	0.70	0.59
Eastbound Total		0.65	0.93	0.66	0.93	0.65	0.93	0.65	0.93
Total Both Directions		0.68	0.76	0.68	0.76	0.68	0.76	0.68	0.76
East Screenline 3: East of Minor Ave, Denny Way to Olive Way	8								
Westbound Total		0.94	0.93	0.93	0.90	0.93	0.90	0.99	1.02
Eastbound Total		1.02	1.11	1.06	1.20	1.02	1.13	1.04	1.12
Total Both Directions		0.98	1.03	1.00	1.06	0.98	1.02	1.02	1.07
East Screenline 2: West of Sixth Ave., Yesler Ave. to S. Jackson St.	9								
Westbound Total		0.29	0.27	0.26	0.27	0.26	0.27	0.26	0.27
Eastbound Total		0.22	0.37	0.21	0.37	0.21	0.36	0.21	0.37
Total Both Directions		0.25	0.32	0.24	0.32	0.24	0.32	0.24	0.32



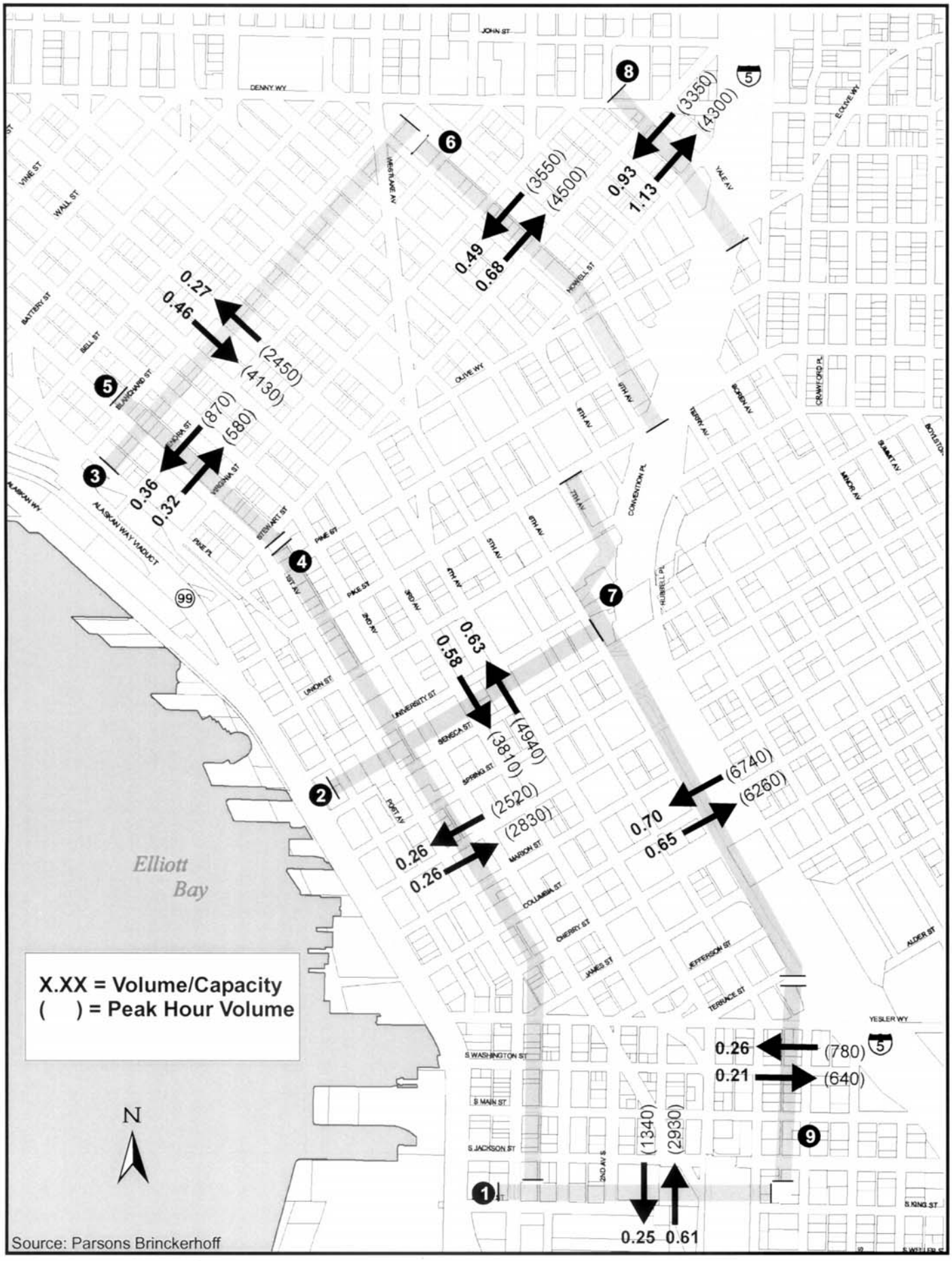
Downtown Height & Density EIS

Figure 9
Screenline Volumes and V/C Ratios for Alternative 1
AM Peak Hour



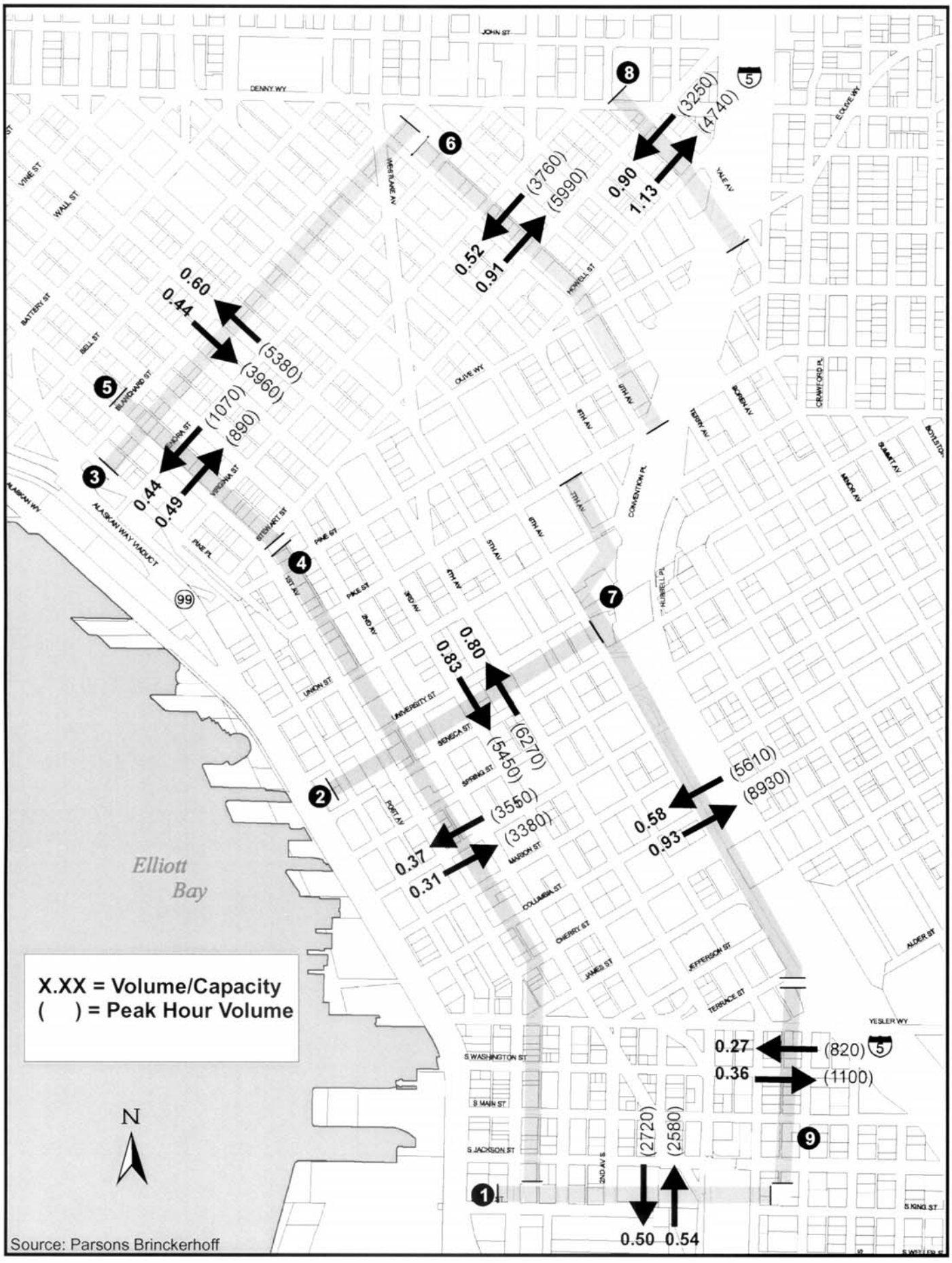
Downtown Height & Density EIS

Figure 10
Screenline Volumes and V/C Ratios for Alternative 1
PM Peak Hour



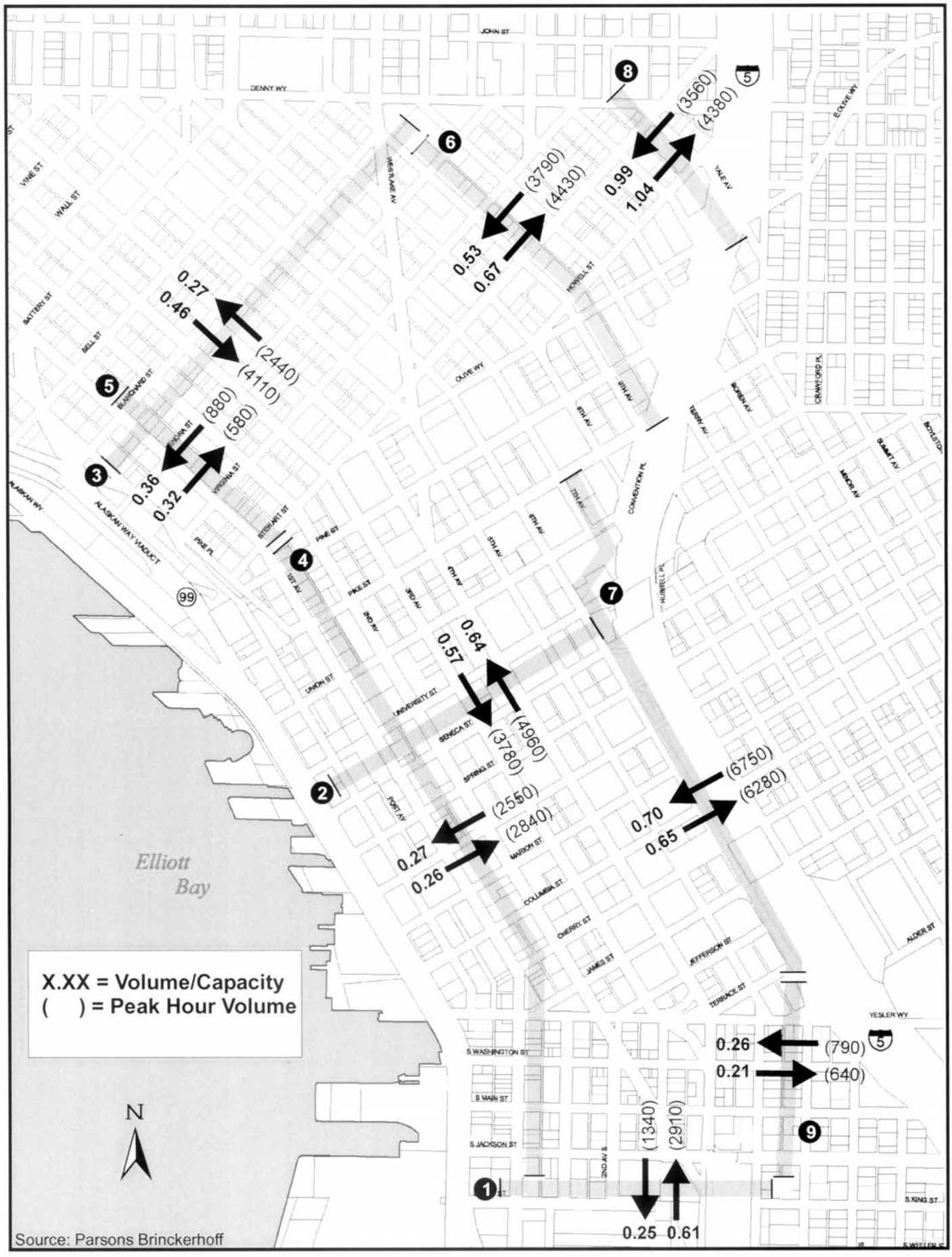
Downtown Height & Density EIS

Figure 11
Screenline Volumes and V/C Ratios for Alternative 2
AM Peak Hour



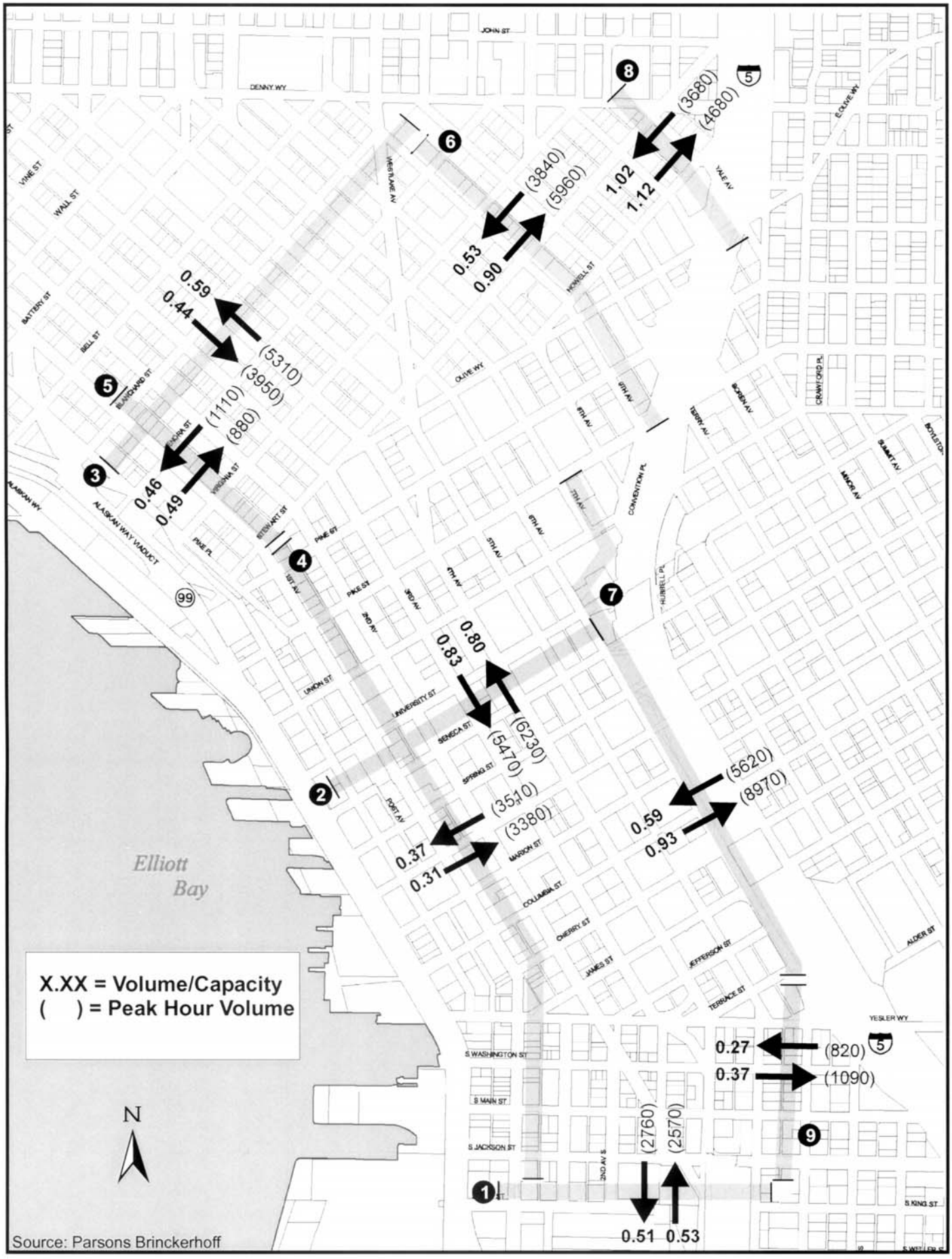
Downtown Height & Density EIS

Figure 12
Screenline Volumes and V/C Ratios for Alternative 2
PM Peak Hour



Downtown Height & Density EIS

Figure 13
Screenline Volumes and V/C Ratios for Alternative 3
AM Peak Hour



Downtown Height & Density EIS

Figure 14
Screenline Volumes and V/C Ratios for Alternative 3
PM Peak Hour

Alternative 3

Projected screenline volume totals for Alternative 3 show very minor differences from Alternative 4 – No Action for all except the following three screenlines:

Screenline 5, east of First Avenue (Stewart to Blanchard St.), westbound in the PM peak hour shows an 8.8 percent increase in volumes.
Screenline 8, east of Minor Avenue, eastbound in the PM peak hour shows a 5.3 percent increase in volumes.
Screenline 9, west of Sixth Avenue (between Yesler and S. Jackson St), westbound in the AM peak hour shows an 8.1 percent decrease in volumes.

The increase across Screenline 5 is relatively minor, and is in the outbound direction in the PM peak hour. This could reflect differences in anticipated development in the immediate Belltown vicinity and the First Avenue/Western Avenue vicinity to the south. The PM peak-hour increase across Screenline 8 (contrary to what is projected for Alternatives 1 and 2) is in the inbound direction, reflecting the higher residential use of the northeast portion of the study area. Similar to Alternatives 1 and 2, the decrease indicated across Screenline 9 is in the inbound direction in the AM peak hour. This may reflect the fact that no zoning changes are proposed for the portion of Downtown south of Yesler Way, and as a consequence more trips are reoriented to areas north.

With respect to inbound/outbound directional patterns, Alternative 3 is projected to be similar to Alternative 4 – No Action in the AM peak hour, with the directional traffic split being 52 percent inbound. In the PM peak hour, Alternative 3 is also very similar, with 57 percent of the traffic outbound as compared to 58 percent in the No Action Alternative. This indicates a slight decrease in outbound traffic with a corresponding slight increase in inbound traffic in the PM peak hour for Alternative 3, compared to Alternative 4 – No Action. This is consistent with the fact that Alternative 3 will have more residential development than any of the other alternatives (including No Action), reflecting an increase in people returning to their homes in the Downtown area in the PM peak hour. PM peak-hour traffic volumes totaled across screenlines are roughly 23 percent larger than AM peak-hour volumes, which is similar to the Alternative 4 – No Action.

Regarding screenline v/c ratios, Alternative 3 is also very similar to Alternative 4 – No Action, with the following four screenlines anticipated to experience ratios of 0.80 or higher, indicating potentially congested operations:

Screenline 2, north of Seneca Street – northbound and southbound in the PM peak hour
Screenline 6, east of Ninth Avenue – eastbound in the PM peak hour
Screenline 7, east of Sixth Avenue - eastbound in the PM peak hour
Screenline 8, north of Minor Avenue - westbound and eastbound in both the AM and PM peak hours

Again, none of the screenlines analyzed are projected to exceed a v/c ratio of 1.20. However, Screenline 8 east of Minor Avenue is expected to be congested, with a v/c ratio of 1.04 in the AM peak hour and 1.12 in the PM peak hour.

B. Traffic Circulation

Tables 20 and 21 list year-2020 intersection levels of service (LOS) and queuing impacts for the three land-use zoning alternatives, in comparison to Alternative 4 – No Action for the AM and PM peak hours respectively. Projected year-2020 intersection LOS results for each of the three alternatives are also shown in Figures 15 to 17 and Tables 22 and 23. These tables respectively show projected AM and PM peak-hour travel-time summaries across the corridors analyzed for each of the alternatives, in comparison with the No Action Alternative. The results in these tables were developed based on output from the Synchro micro-simulation traffic operations model. This section discusses findings by alternative, with respect to these traffic circulation measures. For each Alternative analyzed in this section, the following information is included:

The change in number of intersections projected to be at or exceeding capacity (i.e., LOS E or F), in comparison to Alternative 4 – No Action.

The number of intersections where operations are projected to significantly change from Alternative 4 – No Action (i.e., worsen or improve by two or more LOS levels).

The change in the number of corridor intersection approaches anticipated to have significant queuing impacts (i.e., queues that are expected to back up and affect operations at adjacent intersections).

Significant changes (10 percent or greater) from Alternative 4 – No Action in overall peak-hour corridor travel-time estimates.

Alternative 1

AM Peak Hour

In the AM peak hour for the corridors analyzed, 14 out of 38 intersections are projected to experience year-2020 operating conditions at LOS E or worse for Alternative 1, as compared to 11 for Alternative 4 – No Action. In particular, operational levels appear to deteriorate along Stewart Street and Denny Way, although they improve somewhat along Howell Street. A total of five intersections analyzed are expected to decrease in LOS by two or more LOS levels (compared to the No Action), and two are expected to improve by this amount. Of the five that worsen by this amount, two are along Stewart Street, two are along Denny Way, and one is along Olive Way.

In the assessment of significant queuing impacts projected by the traffic simulation model, there was very little difference between Alternative 1 and Alternative 4 – No Action. This is likely due to the fact that all of the corridors analyzed were already projected to experience significant queuing impacts that would be difficult to worsen. However, the corridor travel time estimates do show some substantial differences between Alternative 1 and Alternative 4 – No Action. Travel through the Stewart Street corridor westbound is projected to be nearly a minute, (or 20 percent) slower with Alternative 1, and nearly 6.5 minutes (52 percent) slower westbound along Denny Way. In contrast, however, the eastbound travel time along Denny Way is projected to decrease by 4.5 minutes, which is 31 percent faster. The decrease in Stewart Street speeds is consistent with the higher rate of growth in jobs and housing in the areas surrounding Stewart Street for Alternative 1, as compared to Alternative 4 – No Action. The changes in travel time

along Denny Way may be due to differences in the distribution of future development in the Denny Triangle vicinity. Development would be more concentrated in fewer projects in the eastern portion of the Denny Triangle under Alternative 1, and spread across more sites west of Westlake Avenue in Alternative 4 – No Action. However, other unidentified factors may also influence travel times along Denny Way.

PM Peak Hour

For year 2020 in the PM peak hour, 19 of the 38 intersections analyzed (50 percent) are projected to experience year-2020 operating conditions at LOS E or worse for Alternative 1, as compared to 17 for Alternative 4 – No Action. Six of 12 intersections along Stewart Street and eight of 12 along Denny Way are expected to operate at LOS E or worse, compared to five and seven intersections respectively for these streets under the No Action Alternative. Conditions at seven of the intersections analyzed are expected to worsen by two or more LOS levels in the PM peak hour as compared to Alternative 4 – No Action; and only two are anticipated to improve by this amount. Three of the intersections for which operations worsen significantly are along Stewart Street, and four are along Denny Way.

Net changes in queuing impacts are not anticipated to be significant along Stewart Street and Denny Way for Alternative 1 in the PM peak hour. This is likely due to the fact that these corridors were already projected to experience significant queuing impacts under the No Action Alternative, and showing them to worsen significantly could challenge the limits of the analysis tools. However, queuing impacts do appear to lessen on Olive Way eastbound. Projected travel-time summaries through the corridors show substantial differences between the two alternatives. Travel through the Stewart Street corridor westbound is projected to be nearly six minutes (50 percent) slower in the PM peak hour with Alternative 1. This is consistent with the higher rate of growth in both jobs and housing in the areas surrounding Stewart Street for Alternative 1, as compared to Alternative 4 – No Action.

In contrast, travel time along Olive Way eastbound is estimated to decrease by over a minute (24 percent), and along Denny Way westbound by over three minutes (16 percent) as compared to Alternative 4 – No Action. As in the AM case, this may be due to differences in the distribution of future development in the Denny Triangle vicinity. Development would be more concentrated in fewer projects in the eastern portion of the Denny Triangle under Alternative 1, and spread across more sites west of Westlake Avenue in Alternative 4 – No Action. However, other unidentified factors may also influence travel times through these corridors.

Table 20
Comparison of Year 2020 Intersection LOS and Queuing Impacts
AM Peak Hour

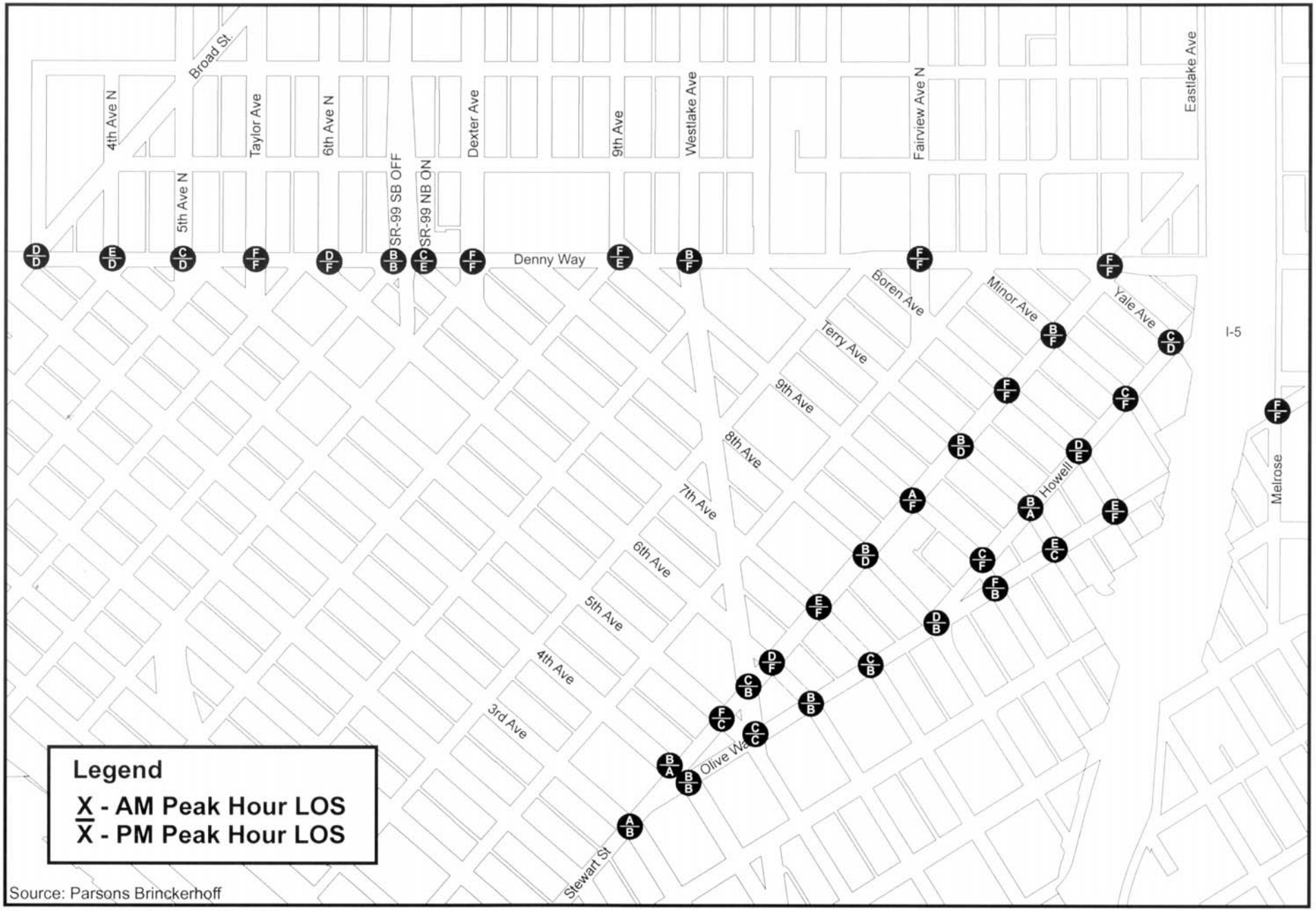
Intersection	2020 No-Action		2020 Alternative 1		2020 Alternative 2		2020 Alternative 3	
	LOS	*Queuing Impacts**	*LOS*	*Queuing Impacts**	*LOS*	*Queuing Impacts**	*LOS*	*Queuing Impacts**
Stewart & 3rd Ave	B	---	A	---	A	---	B	---
Stewart & 4th Ave	B	NB/WB	B	NB/WB	B	NB	B	NB/WB
Stewart & 5th Ave	F	SB/WB	F	SB/WB	F	SB/WB	F	SB/WB
Stewart & Westlake	B	WB	C	WB	B	WB	B	WB
Stewart & 6th Ave	C	WB	D	WB	D	WB	D	WB
Stewart & 7th Ave	B	SB/WB	E	SB/WB	C	WB	E	SB/WB
Stewart & 8th Ave	A	---	B	---	A	---	B	WB
Stewart & 9th Ave	A	---	A	---	A	---	B	---
Stewart & Terry	B	WB	B	WB	B	WB	B	WB
Stewart & Boren	D	SB/WB	F	SB/WB	D	SB/WB	E	SB/WB
Stewart & Minor	B	---	B	---	B	---	B	WB
Howell & Yale	F	SB/EB/WB	C	SB/WB	D	SB/WB	C	SB/WB
Howell & Minor	C	WB	C	WB	D	WB	B	WB
Howell & Boren	E	NB/EB/WB	D	NB/EB/WB	D	NB/EB/WB	F	NB/EB/WB
Howell & Terry	B	---	B	---	B	---	D	---
Howell & 9th Ave	D	---	C	---	D	---	C	---
Howell & 8th/Olive	C	EB	D	EB	B	---	A	---
Olive & Melrose	F	EB/NB	F	EB/NB	B	EB	F	EB/NB
Olive & Boren	F	EB/NB	E	EB/NB	C	EB	C	EB/NB
Olive & Terry	E	EB	E	EB	F	EB	C	EB
Olive & 9th Ave	D	EB	F	EB	C	EB	B	---
Olive & 7th Ave	C	---	C	---	B	---	B	---
Olive & 6th Ave	B	---	B	---	D	NB	B	---
Olive & 5th/Westlake	C	SB	C	SB	C	SB	D	SB
Olive & 4th Ave	B	---	B	---	B	---	B	---
Denny & Stewart	F	EB/WB/SW	F	EB/WB/SW	F	EB/WB/SW	F	EB/WB/SW
Denny & Fairview	F	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB
Denny & Westlake	D	EB	B	EB	B	---	B	EB
Denny & 9th Ave	F	EB/SB	F	EB/SB	B	SB	B	EB/SB
Denny & Dexter	F	EB	F	EB	F	EB/WB	F	EB
Denny & Aurora NB	C	EB/WB	C	EB/WB	E	EB/WB	C	EB/WB
Denny & Aurora SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB
Denny & 6th Ave	C	EB/WB/NB	D	EB/WB/NB	D	EB/WB/NB	B	EB/NB
Denny & Taylor	C	EB	F	EB	F	EB	B	---
Denny & 5th Ave	C	EB	C	EB	D	EB	A	EB
Denny & 4th Ave	B	EB	E	EB	D	EB	B	EB
Denny & Broad	C	EB	D	EB/WB	E	EB/WB	C	WB

* Direction(s) indicated are for those approaches where queues from the specified intersection are expected to back up and affect operations at adjacent intersections.

Table 21
Comparison of Year 2020 Intersection LOS and Queuing Impacts
PM Peak Hour

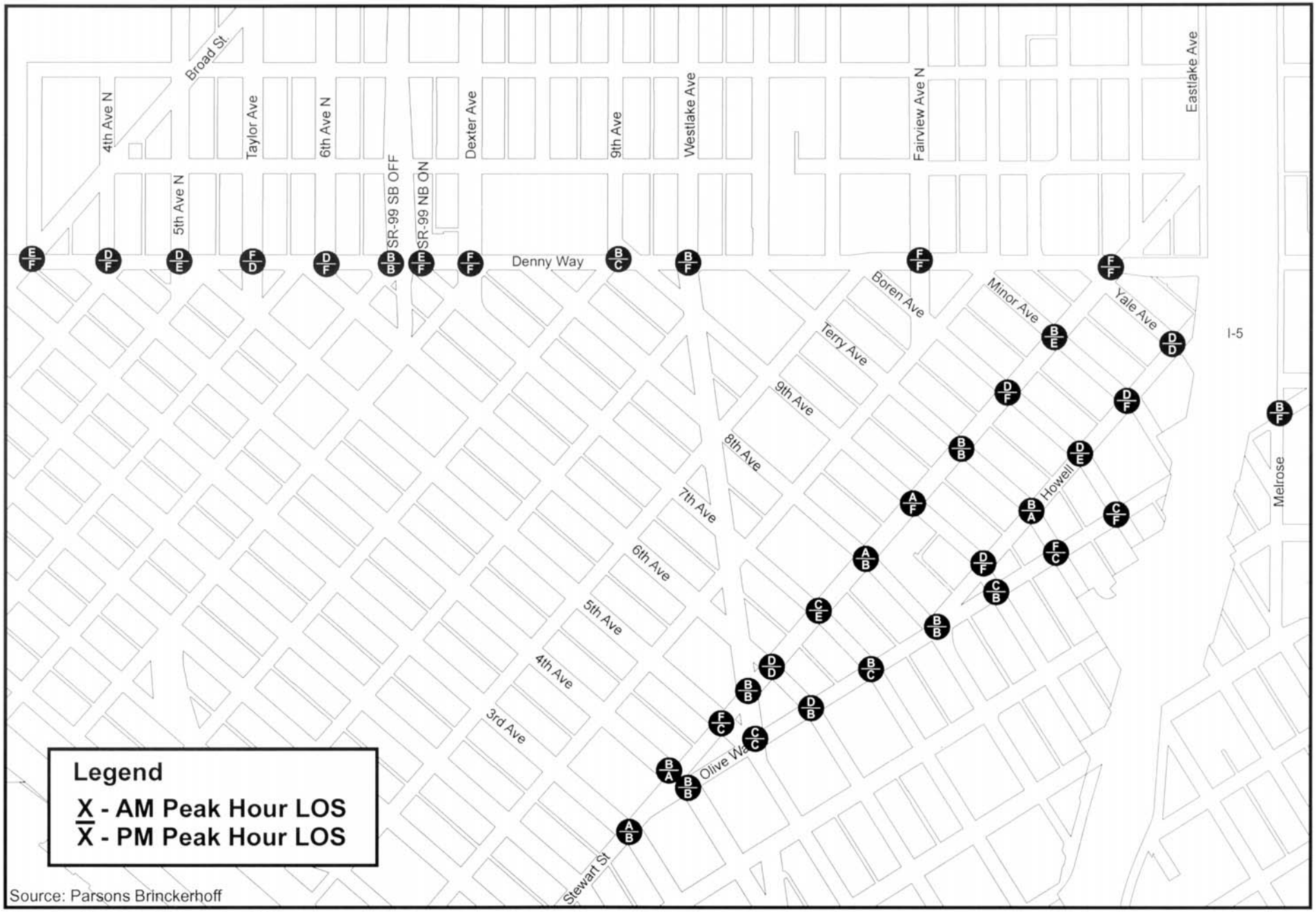
Intersection	2020 No-Action		2020 Alternative 1		2020 Alternative 2		2020 Alternative 3	
	LOS	*Queuing Impacts**	*LOS*	*Queuing Impacts**	*LOS*	*Queuing Impacts**	*LOS*	*Queuing Impacts**
Stewart & 3rd Ave	B	---	B	---	B	---	B	---
Stewart & 4th Ave	A	NB/WB	A	NB	A	NB/WB	A	NB/WB
Stewart & 5th Ave	C	SB/WB	C	SB/WB	C	SB/WB	C	SB/WB
Stewart & Westlake	B	---	B	---	B	---	B	---
Stewart & 6th Ave	C	WB	F	WB	D	WB	C	WB
Stewart & 7th Ave	F	SB/WB	F	SB/WB	E	SB	F	SB/WB
Stewart & 8th Ave	B	---	D	WB	B	---	B	---
Stewart & 9th Ave	F	SB/WB	F	SB/WB	F	SB/WB	F	SB/WB
Stewart & Terry	A	---	D	WB	B	---	B	---
Stewart & Boren	F	SB/WB	F	SB/WB	F	SB/WB	F	SB/WB
Stewart & Minor	F	SB/WB	F	---	E	SB/WB	F	SB/WB
Stewart & Yale	F	SB/WB	F	SB/WB	F	SB/WB	F	SB/WB
Howell & Yale	C	SB/EB	D	SB/EB	D	SB/EB	C	SB/EB
Howell & Minor	F	SB/WB	F	SB/WB	F	SB/WB	F	NB/SB/WB
Howell & Boren	E	---	E	NB/SB/EB	E	NB/SB/EB	E	NB/SB/EB
Howell & Terry	A	---	A	---	A	---	A	---
Howell & 9th Ave	F	SB	F	---	F	SB	F	SB
Howell & 8th/Olive	B	EB	B	---	B	---	D	EB/NB
Olive & Melrose	F	EB/NB	F	EB/NB	F	EB/NB	F	EB/NB
Olive & Boren	F	EB/NB/SB	F	EB/NB/SB	F	EB/NB/SB	F	EB/NB/SB
Olive & Terry	D	EB	C	EB	C	EB	E	EB
Olive & 9th Ave	C	EB/SB	B	EB	B	---	D	EB/SB
Olive & 7th Ave	D	SB	B	---	C	SB	F	EB/SB
Olive & 6th Ave	B	NB	B	NB	B	NB	F	EB/NB
Olive & 5th/Westlake	D	EB/SB	C	SB	C	SB	C	SB
Olive & 4th Ave	B	---	B	---	B	---	B	---
Denny & Stewart	F	EB/WB/SW	F	EB/WB/SW	F	EB/SW	F	EB/WB/SW
Denny & Fairview	D	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB
Denny & Westlake	B	EB/NB	F	EB/NB	F	EB/NB	F	EB/NB
Denny & 9th Ave	B	EB/SB	E	EB/SB	C	EB/SB	D	EB/SB
Denny & Dexter	F	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB	F	EB/NB
Denny & Aurora NB	F	EB/WB/NB	E	EB/WB/NB	F	EB/WB/NB	F	EB/WB/NB
Denny & Aurora SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB	B	EB/WB/SB
Denny & 6th Ave	F	EB/NB	F	EB/NB	F	EB/NB	F	EB/NB
Denny & Taylor	D	EB	F	EB	D	EB	D	EB
Denny & 5th Ave	E	EB/WB	D	EB/NB	E	EB/NB	E	EB/WB/NB
Denny & 4th Ave	F	EB	D	EB	F	EB	F	EB
Denny & Broad	F	EB/WB/NE	D	EB/WB	F	EB/WB/NE	F	EB/WB/NE

* Direction(s) indicated are for those approaches where queues from the specified intersection are expected to back up and affect operations at adjacent intersections.



Seattle Height & Density EIS

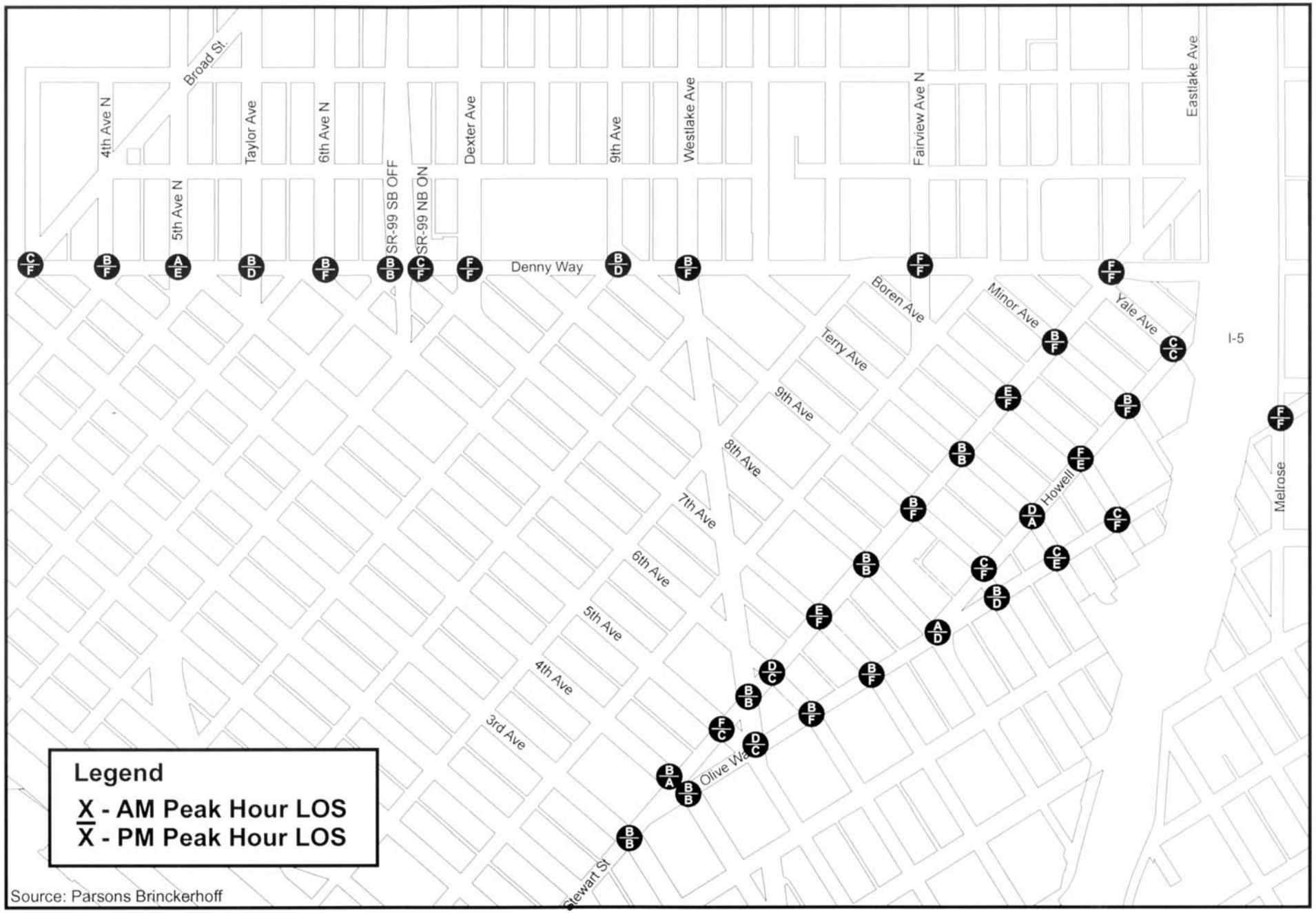
Figure 15
Year 2020 Peak Hour Intersection LOS for Alternative 1



Source: Parsons Brinckerhoff

Seattle Height & Density EIS

Figure 16
Year 2020 Peak Hour Intersection LOS for Alternative 2



Seattle Height & Density EIS

Figure 17
Year 2020 Peak Hour Intersection LOS for Alternative 3

Table 22
Comparison of Corridor Travel Time Summaries by Alternative
AM Peak Hour

	No Action	Alternative 1		Alternative 2		Alternative 3	
Corridor	Time (minutes)	Time (minutes)	% Change from No Action	Time (minutes)	% Change from No Action	Time (minutes)	% Change from No Action
Denny Way Eastbound	12.7	19.3	52%	16.7	31%	14.4	13%
Denny Way Westbound	14.7	10.2	-31%	10.0	-32%	10.0	-32%
Olive Way Eastbound	6.6	6.7	1%	6.0	-8%	4.5	-32%
Stewart Street Westbound	4.4	5.3	20%	4.7	7%	5.7	30%

Table 23
Comparison of Corridor Travel Time Summaries by Alternative
PM Peak Hour

	No Action	Alternative 1		Alternative 2		Alternative 3	
	Time (minutes)	Time (minutes)	% Change from No Action	Time (minutes)	% Change from No Action	Time (minutes)	% Change from No Action
Denny Way Eastbound	19.7	16.6	-16%	14.4	-27%	24.5	24%
Denny Way Westbound	10.6	10.4	-2%	10.1	-5%	10.3	-3%
Olive Way Eastbound	5.3	4.0	-24%	3.5	-34%	6.4	23%
Stewart Street Westbound	11.9	17.8	50%	11.3	-5%	15.0	26%

Alternative 2

In the AM peak hour, 9 out of the 38 intersections analyzed are projected to experience year-2020 operating conditions at LOS E or worse for Alternative 2, as compared to 11 for Alternative 4 – No Action. Overall, operational levels appear to decrease along Denny Way, although they improve along Olive Way and somewhat along Howell Street. Stewart Street is expected to operate similarly as the No Action Alternative. Five of the intersections analyzed for Alternative 2 are expected to decrease in LOS by two or more LOS levels as compared to Alternative 4 – No Action, and five are expected to improve by this amount. Of those that worsen, four are along Denny Way. Of those that improve, three are along Olive Way and Howell Street.

In the assessment of significant queuing impacts projected by the traffic simulation model, conditions are projected to improve somewhat along Stewart, Olive and Howell streets. Denny Way is projected to experience some improvement in the eastbound direction, and some degradation in the westbound direction with respect to queues. This is consistent with travel-time summaries that show travel times decreasing eastbound along Denny Way (by 4.7 minutes, or 32 percent faster), and increasing westbound (by 4.0 minutes, or 31 percent slower). Changes in travel times along Olive and Stewart Streets are expected to change by less than 10 percent. The changes in travel time along Denny Way are interpreted to be due to the location of more future growth away from the Denny Triangle area in this alternative, as compared to Alternative 1 or Alternative 4 – No Action.

In the PM peak hour, 19 of the 38 intersections analyzed (50 percent) are projected to experience year-2020 operating conditions at LOS E or worse under Alternative 2, as compared to 17 for the No Action Alternative. Nine out of twelve intersections along Denny Way are expected to operate at LOS E or worse, as compared to seven in Alternative 4 – No Action. In comparison to the No Action Alternative however, conditions at only two of the intersections analyzed are expected to worsen by two or more LOS levels in the PM peak hour, and none are anticipated to improve by this amount. The intersections for which operations are expected to worsen significantly are along Denny Way. Net changes in queuing impacts are only anticipated to be significant along Olive Way, where they are expected to improve somewhat. Projected travel-time summaries through the corridors show some improvement along Denny Way westbound, for which times are expected to decrease by over five minutes (27 percent); and along Olive Way eastbound, where times are estimated to decrease by nearly two minutes (34 percent). Changes in travel times along Denny Way eastbound and Stewart Street westbound are expected to change by less than ten percent. As indicated for the AM peak hour, these results are interpreted to be due to the location of more future growth away from the Denny Triangle area in this alternative, as compared to Alternative 1 or Alternative 4 – No Action.

Alternative 3

In the AM peak hour, nine of the 38 intersections analyzed are projected to experience year-2020 operating conditions at LOS E or worse for Alternative 3, as compared to 11 for the Alternative 4 – No Action. Overall, operational levels appear to degrade somewhat along Stewart Street, and improve somewhat along Denny Way, Olive Way and Howell Street. Only two of the intersections analyzed are expected to decrease in LOS by two or more LOS levels, as compared to the No Action Alternative, and eight are expected to improve by two or more levels. Of those that improve, five are along Olive Way/Howell Street, and three are along Denny Way. In the assessment of significant queuing impacts projected by the traffic simulation model, conditions are projected to worsen slightly along Stewart Street and to improve somewhat along Olive Way, Howell Street and Denny Way. Travel-time results show an expected decrease in travel times eastbound along Denny Way (by 4.7 minutes, or 32 percent faster), and a slight increase westbound (by 1.7 minutes, or 13 percent slower). Changes in travel times are projected to improve by over two minutes (32 percent) along Olive Way eastbound, and worsen by a little over a minute (30 percent) for Stewart Street westbound, as compared to the No Action Alternative. These results are interpreted to be consistent with projected future growth of housing and employment under Alternative 3.

In the PM peak hour, 22 of the 38 intersections analyzed (58 percent) are projected to experience year-2020 operating conditions at LOS E or worse under Alternative 3, as compared to 17 for Alternative 4 – No Action. The most noticeable changes are along Olive Way, where five out of eight intersections are expected to operate at LOS E or worse (as compared to only two in the No Action Alternative), and along Denny Way where nine out of twelve intersections along Denny Way are expected to operate at LOS E or worse (as compared to seven in the No Action Alternative). For Alternative 3, 6 of the 38 intersections analyzed are expected to worsen in operating levels from the No Action Alternative by two or more grades, and none are projected to improve by this amount. The intersections for which operations are expected to worsen significantly are along Olive Way/Howell Street and Denny Way.
Net changes in queuing impacts are only anticipated to be significant along Howell Street and Olive Way, where they are expected to worsen. Projected travel-time summaries through the corridors show that travel times are expected to increase by close to five minutes (24 percent) along Denny Way westbound, by a little over one minute (23 percent) along Olive Way

eastbound, and a little over three minutes (26 percent) along Stewart Street westbound. Changes in travel times along Denny Way eastbound are expected to change by less than ten percent. The degradation of operations and increase in travel times along both Stewart Street and Denny Way appear to occur primarily in the eastern portion of the corridors, and may be a result of the increased residential and employment growth in that area. The degradation of operations and increase in travel times in Alternative 3 for Olive Way and Howell Street (as compared to the Alternative 4 – No Action are centered around Sixth, Seventh and Eighth Avenues, and may also be a result of increased residential development in the Denny Triangle area.

C. Transit Service

North of Seneca Street Screenline

For the 2020 forecast, AM and PM peak-hour volume-to-capacity (v/c) ratios are similar for the three land-use zoning alternatives, and show little or no change in comparison to the No Action Alternative.

Stewart/Olive Corridors

As shown in Table 24, the alternatives are likely to have mixed results on transit travel time in the Stewart Street and Olive Way corridors. Note that these values represent average peak-hour travel time through the corridors multiplied by the number of peak-hour buses using the corridors. Alternative 2 shows an improvement in overall cumulative travel time through the corridors, due primarily to a 15 percent reduction in PM peak-hour times. Alternatives 1 and 3 have similar overall impacts on travel time (between a 12 and 17 percent increase over Alternative 4 – No Action. Both alternatives are expected to experience the largest relative degradation in travel time in the PM peak hour, where cumulative travel time is projected to be 24 to 25 percent worse than the No Action Alternative.

Table 24
Comparison of Future AM and PM Peak Hour
Cumulative Transit Travel Time (Bus-Minutes) - Stewart/Olive Corridors

Peak Hour	2020 No-Action	2020 Alternative 1		2020 Alternative 2		2020 Alternative 3	
	Travel Time	Travel Time	% Change	Travel Time	% Change	Travel Time	% Change
AM	801	881	10%	793	-1%	771	-4%
PM	942	1164	24%	800	-15%	1177	25%
AM / PM	1743	2045	17%	1594	-9%	1947	12%

Denny Way Screenline

As shown in Table 25, the three alternatives show mixed results when compared to the 2020 No Action Alternative. Although Alternatives 1 and 3 have combined AM and PM delays similar to the No Action Alternative, they show distinctly different patterns in the AM and PM distribution of the delay. Alternative 1 shows a modest reduction in cumulative delay of 7 percent in the PM peak hour, which is offset by an increase in delay of 6 percent in the AM peak hour. Conversely, Alternative 3 shows a significant reduction in AM transit delay of 28 percent, which is somewhat counterbalanced by an increased delay in the PM peak hour of approximately 18 percent.

Table 25
Comparison of Future AM and PM Peak Hour
Cumulative Bus Delay in Minutes - Denny Way Screenline

Peak Hour	2020 No-Action	2020 Alternative 1		2020 Alternative 2		2020 Alternative 3	
	Delay	Delay	% Change	Delay	% Change	Delay	% Change
AM	63	66	6%	79	26%	45	-28%
PM	108	100	-7%	129	19%	128	18%
AM and PM	171	167	-2%	207	21%	173	1%

Table 26 demonstrates that all alternatives show significantly higher delays in the PM peak hour as compared to the AM, indicating that PM peak-hour conditions are expected to be more congested than AM conditions. Under all the alternatives, Fairview Avenue is projected to experience intersection levels of delay greater than 100 seconds. Fifth Avenue, Aurora Avenue and Dexter Avenue show high levels of delay for all alternatives. For all alternatives, little or no increase in delay is anticipated on Fourth Avenue and on Ninth Avenue. For Westlake Avenue, all alternatives show modest levels of delay but sharp increases in PM peak-hour delay over the No Action Alternative. Levels of cumulative bus delay on Westlake Avenue are consistent across all three alternatives.

Table 26
Comparison by Street of Future AM and PM Peak Hour
Bus Delay in Minutes Crossing Denny Way

Crossing	2020 No-Action		2020 Alternative 1		2020 Alternative 2		2020 Alternative 3	
	AM	PM	AM	PM	AM	PM	AM	PM
Fourth Avenue	1	14	3	9	2	17	1	16
Fifth Avenue	9	27	11	16	13	26	2	23
Aurora Avenue	11	31	11	19	32	33	10	35
Dexter Avenue	15	27	15	27	15	27	15	27
Ninth Avenue	8	1	10	4	1	2	1	2
Westlake Avenue	4	2	1	10	1	10	1	10
Fairview Avenue	15	7	15	15	15	15	15	15
Total	63	108	66	100	79	129	45	128

Layover

As shown in Table 27, the impacts of Alternatives 1, 2, and 3 on layover space are less than Alternative 4 – No Action. The alternatives can be categorized as having a similar or marginally lower impact on layover space as compared to the No Action Alternative. Alternatives 1 and 2 have slightly lesser impacts than Alternative 3. However, as previously shown in Figure 5, the differences between the alternatives are confined to a relatively small number of blocks, and therefore a clear distinction cannot be made between the three alternatives.

Table 27
Impact of Alternatives on Layover Spaces

Alternative	Blocks Affected	Potential Displaced Spaces		
		Existing Layover	Potential Layover	Total Spaces
1	5	5	6	11
2	5	5	6	11
3	6	10	5	15
4	8	10	7	17

IV. MITIGATION STRATEGIES

A. Travel Characteristics

With respect to overall travel characteristics, significant changes in travel conditions are projected to occur with or without zoning changes, due to the amount of Downtown growth projected between current conditions and the 2020 baseline condition (Alternative 4 – No Action). For the most affected study screenlines, traffic volume growth is predicted to range from 40 to 90 percent greater in 2020 than under existing conditions. However, in most cases, the projected traffic volumes for the three land-use zoning alternatives would be within 5 percent of the volumes projected for the 2020 baseline condition. The biggest exception is Screenline 8 at the northeast corner of the Denny Triangle near the Denny Way/Stewart Street intersection, where Alternative 1 would result in approximately 8 percent more traffic in the PM peak hour than the 2020 baseline condition. Data from other studied screenlines (#2, 6 and 7) indicate that PM peak-hour traffic in 2020 will use a large portion of the available road capacity in the Downtown commercial core and the Denny Triangle. This information illustrates that regardless of potential zoning changes, growth over 20 years will generate additional traffic volumes and additional strain on the existing street network.

Demand Reduction Strategies

Mitigation strategies to help alleviate these conditions should include measures aimed at reducing vehicle trip growth and increasing the use of transit and carpool options. A sizable increase in transit ridership is already assumed in the analysis of future conditions.

For mitigation to be successful, greater implementation of transportation demand management (TDM) strategies coordinated through worksites is recommended, such as:

Greatly reduced price transit passes (e.g., Flex Pass)
Subsidization of other alternative modes (walking, biking)
Increased telecommuting
Business use of vans
Carsharing
Preferential parking for carpools/vanpools
Guaranteed ride home
Computerized ridematching database and mapping services

These types of strategies have already produced results. For example, between 1993 and 2001, Commute Trip Reduction programs at several larger worksites in Downtown Seattle helped reduce the percentage of workers driving alone to Downtown from 36 percent to 26 percent.[1] This is comparable to a change in demand for vehicle trips from 44 per 100 employees in 1993 to 33 per 100 employees in 2001. A survey by King County[2] in 2000-2001 of eleven Downtown Seattle

[1] Statewide, the percentage of commute trips made by persons driving alone at worksites included in the CTR program declined by 9.3 percent between 1993 and 2001. When all Statewide commuters are considered (including those who work at employers not included in the CTR Program), the drive alone share for commuting increased from 73.9 percent in 1990 to 74.1 percent in 2000. Source: WSDOT, CTR Task Force 2001 Report to the Legislature.

[2] King County, Handout from Oct. 18, 2001 Parking and TDM at Convention Place Meeting

employers with particularly strong TDM programs (including heavily subsidized transit fares through the FlexPass program) found that only 21 percent of these employees drove alone to work. This is comparable to a vehicle trip rate of 26 per 100 employees.

Benefits of Additional Mobility from Possible Transit Improvements

Regardless of alternative, the 2020 condition could experience the benefits of additional travel choices provided by Sound Transit and monorail transit systems that are currently being planning. Alternative alignments under either system could provide additional transit accessibility to portions of the Denny Triangle neighborhood. Specifically, Sound Transit is currently exploring alternative alignments for extending Link Light Rail from Downtown to Northgate. Two alternative alignments under study would bring light rail service to the Convention Place station, providing additional transit accessibility to the southeast portion of the Denny Triangle neighborhood.

The Elevated Transportation Company is also currently exploring alignment alternatives for the monorail in the Downtown area. The West Alternative alignment would serve Downtown along Second Avenue, with proposed station locations at Denny Way, Bell Street, Pike Street, Madison Street, James Street and South Jackson Street. The East Alternative alignment would skirt Downtown and use Denny Way and Boren Avenue. Three station locations for the East Alternative would provide additional transit accessibility around the edge of the Denny Triangle neighborhood, including at Denny Way/Dexter Avenue North, Denny Way/Westlake Avenue, and Boren Avenue/Pine Street. Another alignment option under consideration would provide service in the center of the Denny Triangle neighborhood, with a proposed station location at Westlake and 7th Avenue.

B. Traffic Circulation

The ability for traffic to circulate on the street network will significantly change by 2020, with or without zoning changes. There are relatively limited differences in traffic impacts among the land-use zoning alternatives. The biggest impacts are projected to occur along Stewart Street in the PM peak hour, Olive Way in the AM peak hour, and Denny Way in both directions during both peak hours. The possible mitigation strategies discussed below focus on ways to better accommodate anticipated traffic demands. Because of right-of-way constraints and the overwhelming cost of significant expansion of Downtown streets, the measures considered here are limited to strategies such as the optimization of traffic signal timings, and alternate uses of street pavement (e.g., utilizing parking lanes for travel during peak periods). However, for one location (the intersection of Stewart Street and Denny Way), a grade-separated intersection is presented as an option. Also, the potential benefits of Alaskan Way Viaduct Project improvements to the east-west grid network across Aurora Avenue are qualitatively addressed.

It should be noted that of the mitigation measures discussed, the only ones analytically assessed are those that involve converting parking lanes to travel lanes during peak periods. These are analyzed for Stewart Street and Olive Way. A quantifiable assessment of how signal timing optimization might improve operations along the three corridors analyzed was not conducted, because analyzing these corridors independently from the rest of the Downtown street network would not provide meaningful results, and assessing operations throughout the entire Downtown street system is beyond the scope of this study. However, a qualitative assessment of the potential effect of signal timing improvements on corridor operations is provided.

Potential Mitigation Strategies for Stewart Street

Restriping Stewart Street between Yale and Sixth Avenue to allow for four ten-foot travel lanes and (along most segments) an eight-foot parking lane during the AM and PM peak periods

Parking would be allowed in the off-peak hours on both sides through much of the corridor, as is the situation today. An assessment of this strategy using the Synchro traffic simulation model indicates that this could decrease average travel times through the corridor by 1.2 minutes (or about 10 percent) in the PM peak hour. However, in the AM peak hour, it appears to result in a slight increase in delay through the corridor. Model results indicate that although this strategy is expected to decrease delay at intersections in the northeastern portion of the corridor (Yale through Eighth Avenue), delay is likely to increase slightly at intersections in the downstream portion (Seventh through Third Avenues), so that the net delay through the corridor is 0.4 minutes greater with the restriping option. This is likely due to the fact that the added capacity in the northeastern section would allow more traffic into the system, and cause greater impacts to the southwestern portion of the system where capacity would not be added. This effect was also noted to occur in the PM peak hour, however unlike the AM peak hour, in the PM peak hour the amount of delay reduction in the northeastern section of the corridor significantly outweighs the amount of additional delay noted in the southwestern portion.

A second restriping option for Stewart Street between Yale and Sixth Avenue

A second restriping option was also considered, which allowed for four 12-foot travel lanes and no on-street parking during the AM or PM peak periods. On-street parking would be allowed on the right side during the off-peak hours and three lanes would be used for off-peak travel. An assessment of this strategy using the Synchro traffic simulation model indicates that it could decrease travel times through the corridor by close to a minute, resulting in a six percent improvement in the PM peak hour. In the AM peak hour, the net change in delay would be negligible.

Retiming traffic signals along Stewart Street

Retiming these traffic signals would help optimize corridor traffic flow. This strategy is expected to have the most significant effect on PM peak-hour operations, because the signals are already timed to facilitate traffic progression in the AM peak hour, but not necessarily in the PM peak, since this is currently the “off-peak” direction.

Constructing a grade-separated intersection of Stewart Street with Denny Way

This intersection is currently operating at LOS F, and is an important crossroads adjacent to the Denny Triangle area, which is projected to receive a large amount of growth over 20 years. Traffic operations at this location are anticipated to degrade significantly. Grade-separating this intersection could provide significant relief to both the Denny Way and Stewart Street corridors.

Potential Mitigation Strategies for Olive Way

Restriping Olive Way between Fourth and Eighth Avenues

This restriping would allow for four travel lanes during both the AM and PM peak periods. Parking would be allowed in the off-peak period where it exists today. An assessment of this strategy using the Synchro traffic simulation model indicates that this could decrease travel times through the corridor by two minutes (31 percent) in the AM peak hour, and by 1.7 minutes (32 percent) in the PM peak hour.

Retiming traffic signals along Olive Way to optimize corridor traffic flow

This strategy is expected to have the most significant effect on AM peak-hour operations, because the signals are already timed to facilitate traffic progression in the PM peak hour, but not necessarily in the AM peak hour, since this is currently the "off-peak" direction.

Potential Mitigation Strategies for Denny Way

Constructing a grade separated intersection of Stewart Street with Denny Way

See previous discussion.

Placing Aurora Avenue in a tunnel from the downtown area to north of Mercer Street

This is an improvement in the South Lake Union area that is being considered as part of the Alaskan Way Viaduct Project. This would allow the reconnection of several east/west arterial streets currently severed by Aurora Avenue north of Denny Way. This would allow for more east/west traffic capacity, and potentially reduce the amount of traffic using Denny Way (particularly in the western portion of the corridor). Although assessment of these impacts to Denny Way are beyond the scope of this study, separate studies analyzing the overall impacts of these improvements are currently underway.

C. Transit Service

The greatest level of change in transit service conditions is projected to occur with or without zoning changes, between now and the 2020 baseline condition (Alternative 4 – No Action), due largely to the influence of general traffic conditions. This is projected to be the case in the Stewart Street and Olive Way corridor, where the most noticeable impact would occur in the PM peak hour. In comparison, Alternatives 1 and 3 would generate an approximately 25 percent greater impact than Alternative 4 – No Action in the PM peak hour. The AM peak-hour delay for all alternatives (including No Action) would be approximately the same. In the Denny Way corridor, overall delay would be roughly equivalent, with the exception of Alternative 2, which shows a 21 percent additional increase in delay over the No Action Alternative.

As with traffic-oriented strategies, appropriate mitigation strategies for transit include those aimed at reducing the overall number of trips on these streets and/or enhancing traffic flow. In most cases, traffic circulation mitigation will have corresponding benefits for transit. However, the following transit-specific mitigation measures may also have merit:

Restriping Stewart Street and Olive Way to accommodate a right-side peak-period transit-only lane

On Stewart Street, the transit lane would begin north of Yale Street and end at Sixth Avenue. On Olive Way, it would run between Fourth Avenue and Eighth Avenue. Restriping would allow for up to three twelve-foot travel lanes and a twelve-foot transit-only lane on Stewart Street. Along Olive Way, less curb-to-curb width is available, so at some points the transit lane could be 11 to 12 feet in width, and other travel lanes would be nine to ten feet wide. The transit-only lane could be available for parking during off-peak hours. An assessment of this strategy was made using the Synchro traffic simulation model to assess general-purpose lane operation, and a separate methodology from the 1999 NCHRP HOV Systems Manual was used for estimating arterial HOV/transit lane delay. The evaluation indicates that this approach could improve average bus travel times along Stewart Street by 1.2 minutes (27 percent) in the AM peak hour, and 8.3 minutes (70 percent) in the PM peak hour. Note that a significant portion of the travel-time savings (nearly 5 minutes) in the PM peak hour is projected to occur at Yale Avenue. If the transit lane started downstream of this intersection, or not far enough upstream of the intersection to provide an adequate queue bypass, the improvement would be much less. Along Olive Way, the transit lane would have a more modest effect, reducing AM peak-hour travel times by approximately one minute in both the AM and PM peak hours, which is equivalent to a 15 and 19 percent improvement, respectively.

Another way to assess the effect of this potential mitigation measure is to factor in the number of buses expected to travel the corridor and experience the travel-time savings. For Stewart Street and Olive Way combined, implementing transit lanes would result in an overall decrease of 161 minutes in peak-hour bus-minutes of travel (25 percent improvement) in the AM peak hour, and a decrease of 484 minutes (106 percent improvement) in the PM peak hour.

The impact on general-purpose traffic is also of interest for this potential strategy. The Synchro traffic simulation model does not explicitly simulate transit lanes, but this impact was assessed in Synchro by modeling three general-purpose lanes and removing right-turning vehicles, buses and bus operations from the traffic stream (these movements are instead assumed to occur in the adjacent transit-only lane). With this configuration, model results indicate that operations along Stewart Street would improve slightly in the AM peak hour, with average travel time through the corridor reduced by 0.5 minutes (11 percent) in the general-purpose lanes, compared to the No Action Alternative. PM peak-hour results along Stewart Street are more pronounced, with travel times projected to decrease by 2.4 minutes (roughly 20 percent). Along Olive Way, AM peak-hour results show a travel time improvement for general-purpose traffic of 1.8 minutes (27 percent) over the No Action Alternative. PM peak-hour results showed no noticeable change in travel times for general-purpose traffic with this measure.

In the Denny Way corridor, target transit queue jumps at intersections with significant queues.

Under all of the alternatives, Fairview Avenue North would experience the longest queues and would likely benefit from a queue jump. Other intersections with significant delays that could also benefit from a signal queue jump include Fifth Avenue North, the Aurora Avenue North ramps, and Dexter Avenue North.

V. SIGNIFICANT UNAVOIDABLE ADVERSE IMPACTS

Without mitigation, future development through the year 2020 would generate additional traffic volumes and increase congestion in portions of Downtown, most notably in the Denny Triangle area. Much of this impact would occur with or without zoning changes. However if the higher-density zoning changes (Alternatives 1 and 2) considered in this study are implemented, congestion in the most affected areas could be approximately 5-10 percent worse than for other alternatives, including the 2020 baseline condition (Alternative 4 - No Action). Under all the alternatives considered, additional congestion will likely increase overall travel times on Denny Way, Stewart Street and Olive Way, including transit travel time. Implementation of mitigation strategies, at the City's discretion, would likely improve overall transportation conditions, so that a portion of the impacts of traffic congestion could be avoided.

APPENDICES

Appendix 1
List of Screenline Streets

Number	Title and Cross Street Names
1	**North of S. King Street**
	First Avenue
	Occidental Avenue
	Second Avenue
	Fourth Avenue
	Fifth Avenue
	Sixth Avenue
2	**North of Seneca Street**
	Western Avenue
	First
	Second
	Third
	Fourth
	Fifth
	Sixth
3	**South of Blanchard Street**
	First Avenue
	Second Avenue
	Third Avenue
	Fourth Avenue
	Fifth Avenue
	Sixth Avenue
	Seventh Avenue
	Eighth Avenue
	Westlake Avenue
	Ninth Avenue
4	**East of First Avenue**
	S Jackson Street
	S Main Street
	S Washington Street
	Yesler Way
	James Street
	Cherry Street
	Columbia Street
	Marion Street
	Madison Street
	Spring Street
	Seneca Street
	University Street
	Union Street
	Pike Street
	Pine Street

Appendix 1 (continued)
List of Screenline Streets

Number	Title and Cross Street Names	
5	**East of First Avenue**	
	Stewart Street	
	Virginia Street	
	Lenora Street	
	Blanchard Street	
6	**East of Ninth Avenue**	
	Lenora Street	
	Virginia Street	
	Stewart Street	
	Howell Street	
	Olive Way	
	Pine Street	
	Pike Street	
	Pike I-5 ramp	
7	**East of Sixth Avenue**	
	Union Street	(I-5 ramp)
	University Street	(I-5 ramp)
	Seneca Street	
	Seneca Street	(I-5 ramp)
	Spring Street	
	Spring Street	(I-5 ramp)
	Madison Street	
	Columbia Street	(I-5 ramp reversible)
	Columbia Street	
	Cherry Street	
	Cherry Street	(I-5 ramp reversible)
	James Street	
	James Street	(I-5 ramp)
	6th Avenue n/o Yesler Way	
8	**East of Minor Avenue**	
	Denny Way	
	Stewart Street	
	Howell Street	
	Olive Way	
9	**West of Sixth Avenue**	
	Yesler Way	
	S Washington Street	
	S Main Street Street	
	S Jackson Street	